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This proceedings contains the papers presented at SITE 98, the ninth annual international conference of the Society for Information Technology & Teacher Education. Papers are listed under the following headings: "Concepts and Procedures" (18 papers); "Distance Education" (23 papers); "Diversity" (8 papers); "Educational Computing Course" (7 papers); "Educational Leadership" (21 papers); "Faculty Development" (12 papers); "Graduate and In-Service Education" (15 papers); "Instructional Design" (14 papers); "International" (17 papers); "Mathematics" (14 papers); "New Media" (13 papers); "Preservice Teacher Education" (23 papers); "Reading and Language Arts" (11 papers); "Research" (25 papers); "Science" (12 papers); "Simulation" (6 papers); "Social Studies" (5 papers); "Special Needs" (3 papers); "Technology Diffusion" (10 papers); "Telecommunications: Graduate, In-service, and Faculty Use" (9 papers); "Telecommunications: Preservice Applications" (12 papers); "Telecommunications: Systems and Services" (27 papers); "Theory" (12 papers); "Young Child" (9 papers); and the keynote address. The preface and dedication of the proceedings are also included. (AEF)

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Proceedings of SITE 98–

Washington, DC
March 10-14, 1998

General Editors –
Sara McNeil
Jerry D. Price
Stephanie Boger-Mehall
Bernard Robin
Jerry Willis

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P R E F A C E

Do We Still Need a Paper Annual?

This is the ninth Technology and Teacher Education Annual, and as I think about it a conversation I had in 1989 floats up from one of those mental storage bins that are never thrown out but rarely opened and examined. The conversation was over whether it made any sense to have an annual conference on the topic of information technology and teacher education (ITTE). My colleague had strong views. He felt that there were enough projects to support one conference. Thus, one conference was a good idea, but planning others made little sense. Once those few projects that were being undertaken had been presented there would be no content for future conferences. He felt the same way about creating a journal; there were simply not enough papers to support a journal!

There was plenty of evidence that my colleague's opinions were accurate. No one else had ever tried to arrange an annual conference on the topic - if there was a need it would already have been done. There was no journal on the topic. There were only a few papers on ITTE, and they were scattered all over the computers and education literature.

But, now, looking back over 9 years of SITE conferences and Annuals, it is clear that my colleague was wrong. Early conferences were small but they have grown each year. The 1998 Annual is over 7, **SEVEN!**, times the size of the first Annual. Attendance at the conference has grown each year and the number of presentations has grown. The weight of the paper version of the 98 Annual will attest to that. There is now an established discipline of both scholarship and professional practice - information technology and teacher education (ITTE) - that supports three journals and one Annual. The three journals, *Journal of Technology and Teacher Education*, *Journal of Information Technology for Teacher Education*, and *Journal of Computers and Teacher Education*, publish a total of less than 100 papers a year, and the Annual takes another 400-500.

The journals, the Annual, and the existence of organizations like SITE, are all indications of a thriving and maturing field. Browsing through the Chronicle of Higher Education job ads is another way of judging the viability of our field. About five years ago the University of Utah advertised a tenure track assistant professor position in "Technology and Teacher Education." That, to my knowledge, was the first position advertised that specifically identified the field as ITTE. Today many of the job ads related to technology will include at least a mention of the need for experience and expertise in ITTE. That was not the case fifteen years ago.

If I had any doubts about the viability of our field, ITTE, they were put to rest a few weeks ago when I had occasion to look through the applications for a faculty position in instructional technology. Over 60% of the applicants had published in one of the three journals or presented at SITE. Many members of the new generation of instructional technology doctorates have experience in and long term interests in ITTE. That suggests the Annual and the conference will continue to grow and that we will, for the foreseeable future, be working with a significant number of new people who are just beginning their careers as ITTE practitioners and scholars. The Annual is both a valuable publication outlet for them and a source of knowledge.

That, however, brings me to another point. Do we still need a paper version of the Annual? It has been too heavy to carry around the conference for several years and it has become a nightmare to produce in the short time between December 1 and the conference in March. The CD-ROM version of the Annual is full-text searchable, and papers can be printed out as needed. In addition, the Annuals are available over the Internet so that anyone with a connection to the World Wide Web can find them. Do we need a paper version as well? I won't give you my opinion on this issue, but I do believe it is time for us to think seriously about the question. I hope, as we celebrate and enjoy another SITE conference, that you will think about this question. If you feel strongly one way or another why not send me an e-mail message explaining how you feel and why. Send it to jerryw@iastate.edu.

Jerry Willis
Founder, SITE

DEDICATION

Gary Marks, *a scholarly communications pioneer*

About 16 years ago a young doctoral student at the University of Texas in Austin became interested in the emerging field of educational computing. There were a few publications like T.H.E. Journal and The Computing Teacher that dealt with the use of computers in education, but for the most part all of us were still reading general publications like Byte Magazine. Gary Marks, while a doctoral student, saw the need for more specialized publications. He began a modest little publication titled, Journal of Computers in Math and Science Education. It actually began as a newsletter but rapidly progressed to the status of a journal. It is still in print, and it was one of the first, if not the first, publications that appealed to scholars and thoughtful practitioners in a specialized area of educational computing.

The 1998 Annual is dedicated to Gary Marks because he saw a need and instead of waiting for someone else to meet that need, he acted. The "need" was a way for people interested in the use of computers in math and science teaching to communicate with each other.

The 98 Annual is also dedicated to Gary Marks because he not only saw a need, he did a good job of meeting that need. In 1981 there were a number of publications on education and computing that can best be described as "chatty." They lacked the depth a growing number of enthusiasts wanted in a publication. Gary's first journal balanced practical issues with coverage of conceptual and theoretical topics that were important to both researchers and practitioners.

The 98 Annual is not dedicated to Gary Marks because he sought out the honor. In fact, when told about the decision, he tried to discourage us and suggested several others he thought were more deserving. If you are a Wizard of Oz fan, Gary prefers the role of the man behind the curtain. He is comfortable working behind the scenes, and bringing him out from behind the curtain required some effort. But that characteristic, his willingness to work hard to meet a need without seeking or needing high visibility, is probably one reason he has been so successful.

Gary's first journal was published by the Association for Computers in Math and Science Teaching. That was really another name for Gary Marks. In true Madison Avenue style he invented an organization to publish his journal because that gave it more credibility. It reminds me of how one of the computer accessory companies got its name. The fellows who founded the company on a shoestring lived on Curtis Street and they named the company Curtis because it would give the impression that they were doing more than working out of their garage. Gary's, or ACMST's, journal prospered, however, because it met a need and was provided at a reasonable cost.

Before Gary left Texas he realized there was a need for other journals and he changed the name of the association to the Association for the Advancement of Computing in Education. AACE is alive and well today because of Gary Marks and his vision of what was needed as well as his ability to meet those needs. AACE is still a small organization as organizations go, but it plays a very important, even critical, part in the dissemination of scholarship about technology and education. AACE still publishes the original journal on science and math teaching and six others on everything from distance education, early childhood, multimedia, and interactive learning to teacher education.

AACE also supports and organizes six conferences, including SITE, and it has active organizations or divisions associated with most of the journals. AACE also has several "chapters" - there is one in central Europe, another in the Asia Pacific region, and a third in Latin America. All of this, the journals, the conferences, and the chapters, were created because Gary had a vision and the ability to meet that need.

So, we dedicate this Annual to someone who has made a difference in the field. Many important channels of scholarly communication exist today because of the effort and vision of Gary Marks. He is someone who has truly made a difference. The organization he created is the home of SITE, the Journal of Technology and Teacher Education, the SITE conference, and the Technology and Teacher Education Annual. Without AACE, SITE might have faded from the scene after a few years because of burnout. It is difficult for volunteers who have other responsibilities to do all the things that are required to keep an organization healthy. With AACE, SITE is a thriving, healthy organization.

Jerry Willis

Concepts and Procedures

Section Editors:

Deborah Bauder, *SUNY Institute of Technology at Utica/Rome*
Rosemary Mullick, *SUNY Institute of Technology at Utica/Rome*
Ronald Sarner, *SUNY Institute of Technology at Utica/Rome*

Most of the selections in this section reflect on some facet of the question: what information processing skills do students and teachers need to possess and how do educators insure that they, both teachers and students, are well prepared? The wide variety of projects and differing approaches clearly suggests that these are still open questions.

The first group of three papers deal largely with the skill set that is required in the information age. The first selection by Edward Caffarella of the University of Northern Colorado reviews a draft of new information literacy standards under development by the Association for Educational Communications and Technology and the American Association of School Librarians. This group has developed nine standards in three broad categories: information literacy, independent learning, and social responsibility. In the second paper, David Kumar and Valerie Bristor of Florida Atlantic University call attention to the integration of knowledge and subject matter focusing upon projects that combine both the physical sciences and language arts. Another demand often made of American education is to produce graduates whose skill set meets the needs of business. The third paper, by Ronald Abate of Cleveland State University describes a collaborative venture, based on the Ohio Goals 2000 Program, among Cleveland State's College of Education, its Advanced Manufacturing Center, and local schools.

The second group of selections focuses upon how to prepare teachers to teach adequately with technology; some in the group focus on a logically prior question - how to train the trainers, the university teacher education faculty. Two such projects at Michigan State University are examined. The first, by Andrew Topper, describes the use of "technology guides" who assist both faculty and graduate students in the teacher education program. The second, by Christina Dokter, Kaijun Hou, and Larry Heimann describes a project to support a faculty member and his graduate statistics students through the development of world-wide-web based materials.

Several selections focus upon pre-service and in-service training. David Breihaupt and Karen Smith-Gratto of North Carolina A&T State University present a model for teacher training that pairs pre-service students with professional teachers to develop computer-based instruction and materials collaboratively. Madeline Justice of Texas A&M University-Commerce and Ida Gunstanson of the Terrell Middle School describe a collaboration between Texas A&M and its surrounding public schools, "...using a combination of technology and both new and traditional teaching methods to improve the skills and abilities of preservice teachers."

Five researchers from Eastern Kentucky University, Mary Ann Koloff, JoAnna Dickey, Shirley Long, Sue Reehm, and Joyce Harris Thomas, describe how EKU plans to use technology-based portfolios to document the achievements of its pre-service students. Tina Marshall-Bradley and George Bradley of South Carolina State University describe the pre-service program at their institution, contrasting technology usage with national data. In the next paper, Nancy Luke, Joi Moore, and Sally Sawyer, all from the University of Georgia present a literature review stressing the need to integrate theory and practice. They note that authentic usage of technology, where the technology is used in a "real life" setting, helps teachers more easily integrate the technology into their work.

Elizabeth Willis of Northern Arizona University reflects upon a series of pre-service courses that she was teaching during the 1996-97 academic year. Unlike previous methods courses, during this year Willis integrated the social studies and language arts courses into a single class in which technology played an integral part. In addition to the author's own comments, the paper draws extensively upon the personal narratives of her students.

Next, Marianne Handler of National Louis University and seven other Illinois educators at four other colleges and the National Center for Supercomputing Applications

(NCSA) present a description of PIE-21, Preparing Educators for the 21st Century. This program combined preservice and in-service training for teachers, administrators, and teacher education faculty. This descriptive paper catalogs the varied approaches that were tried at the constituent institutions.

Two of the selections in this group focus upon the collegiate technology environment. Patricia Shopland and Joan Kannegieser of Eastern Nazarene College chronicle the difficulties encountered in establishing a computer lab at their institution and remind us of the challenges that are faced in departments and colleges that are steeped in tradition. At the other extreme, James Laffey, Dale Musser, and John Wedman of the University of Missouri-Columbia describe the challenges presented by a very exciting project to infuse technology into pre-service education. In a four-part program, Missouri-Columbia first identified a series of technical competencies or "milestones" that they expected of their graduates. To assist in meeting these competencies, all incoming freshmen (and all thirty education faculty) were provided with Apple Powerbook laptop computers. This infusion of equipment required the development of a support system, called the "Reflector". In addition, an internet-based tool was developed to enable students to create and maintain journals, and finally a partnership was forged with nineteen school districts around the state.

The three remaining papers present projects that are not directly related to teacher preparation. William Stockebrand and Christine Althoff of the University of Texas at El Paso describe their department's involvement with Phi Delta Kappa's National Values Project. In this endeavor, UTEP graduate students act as catalysts and facilitators for research projects. In the second selection, Catherine Alfieri of the Jefferson Road School in Pittsford, NY describes the development of website in conjunction with a fourth grade social studies curriculum. In the final paper, Carlos Solis of Rice University traces the development of the "Electronic Studio", a series of intranet-based projects using a web-browser as a common interface.

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The New Information Literacy Standards for Student Learning: Where do they fit with other content standards?

Edward P. Caffarella
University of Northern Colorado

There are two major factors driving the information literacy skills needed by students as we move into the 21st Century. The two factors are the growth in the quantity of information sources and the ease of access to that information. The amount of information available is growing at exponential rates with the quantity doubling every few years. Along with this rapid growth in the sheer quantity of information, the means for accessing this information has become easier. Electronic databases have placed much of the information within the reach of a few computer keystrokes.

These parallel developments present an interesting challenge for the current K-12 students who will live their adult lives in the 21st century. There will be enormous warehouses of information that is readily and directly available to the end users. Some of this information will be good while some will be bogus. The end user will need to locate the appropriate information and then separate the proverbial wheat from the chaff.

Information Literacy Standards for Student Learning

To meet this challenge the Association for Educational Communications and Technology and the American Association of School Librarians formed a committee to write a new edition of *Information Power* (American Association of School Librarians and Association for Educational Communications and Technology [AASL/AECT], 1988) and investigate the information literacy needs of K-12 students over the next twenty years. The author of this paper is a member of that committee. This committee has developed a set of nine information literacy standards for student learning. These standards will be published in their final form in June of 1998 (AASL/AECT, 1998). The preliminary drafts of the standards and related materials are available at http://www.ala.org/aasl/infopwrmenu.html.

The purpose of this paper is to investigate the standards and the interface of these standards with other subjects typically taught in schools. The nine standards are divided into three broad categories. The standards in the second and third categories are dependent upon the standards in the first category. The standards are:

Category I: Information Literacy
The student who is information literate:

Standard 1: Accesses information efficiently and effectively
Standard 2: Evaluates information critically and competently
Standard 3: Uses information effectively and creatively

Category II: Independent Learning
The student who is an independent learner is information literate and:

Standard 4: Pursues information related to personal interests
Standard 5: Appreciates and enjoys literature and other creative expressions of information
Standard 6: Strives for excellence in information seeking and knowledge generation.

Category III: Social Responsibility
The student who contributes positively to the learning community and to society is information literate and:

Standard 7: Recognizes the importance of information to a democratic society
Standard 8: Practices ethical behavior in regard to information and information technology
Standard 9: Participates effectively in groups to pursue and generate information

In the complete documentation of the standards (AASL/AECT, 1998) there is a set of indicators under each standard. These indicators provide further definition of the standards. Each standard is written as a lifelong skill and is therefore not grade specific.

In the following sections each standard will be discussed separately. Some of the links to other subject area standards will also be identified. The publication entitled

Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education (Kendall & Marzano, 1997) has been used for standards in other subject areas. The links to other subject areas are not meant to be exhaustive but rather to suggest how the information literacy standards can be taught within the context of other subject areas. The committee has made the assumption that the information literacy standards will not be taught separately but will be integrated with other subject areas.

Category I: Information Literacy

Standard 1:

The student who is information literate accesses information efficiently and effectively. The student who has achieved this standard recognizes the need for information, realizes that accurate and comprehensive information is the basis for intelligent decision making, formulates appropriate research questions, identifies potential information sources, and uses successful strategies to locate information. A student might look to an almanac for climatic information on a specific country but look at a thermometer when deciding to wear a coat on a fall day. In both cases the information is weather related but the purpose of the search determines possible sources of information.

Since most classes have at least some part dealing with where to find information on the discipline, this standard can be taught in a wide variety of classes such as those in the following list.

Civics: Knows how shared ideas and values of American political culture are reflected in various sources and documents (Kendall & Marzano, 1997, p. 434).

Geography: Knows the basic elements of maps and globes (*e.g.*, title, legend, cardinal and intermediate directions, scale, grid, principal parallels, meridians, projection) (Kendall & Marzano, 1997, p. 510).

Health: Knows local, state, federal, and private agencies that protect and/or inform the consumer (Kendall & Marzano, 1997, p. 546).

Mathematics: Formulates a problem, determines information required to solve the problem, chooses methods for obtaining this information, and sets limits for acceptable solutions (Kendall & Marzano, 1997, p. 47).

By combining the teaching of the information literacy standard with the appropriate subject matter the student will see the importance of gathering information to all disciplines.

Standard 2:

The student who is information literate evaluates information critically and competently. To master this standard the student must complete tasks such as determining the accuracy, distinguishing among facts and opinions, identifying inaccurate information, and selecting information appropriate to the problem. When evaluating information the student might be making a decision that information in the supermarket tabloids is highly sensationalized and may not reflect reality. Conversely the information found in a refereed scholarly journal is probably highly accurate.

This information literacy standard can be taught in concert with the other content standards. Some of the possible content area standards are listed below.

English language arts: Determines the validity and reliability of primary and secondary source information and uses information accordingly in reporting on a research topic (Kendall & Marzano, 1997, p. 333).

Health: Knows how to determine whether various resources from home, school, and the community present valid health information, products, and services (Kendall & Marzano, 1997, p. 546).

Mathematics: Knows the difference between pertinent and irrelevant information when solving problems (Kendall & Marzano, 1997, p. 46).

Science: Understands how scientific knowledge changes and accumulates over time (Kendall & Marzano, 1997, p. 99).

Any one of these standards could be used as an opportunity to teach the second Information Literacy standard.

Standard 3:

The student who is information literate uses information effectively and creatively. The student uses the information by organizing it, integrating the new information into one's own knowledge, and communicates information. The use of the information may take the form of a traditional term paper or a page for the World Wide Web. The use may also take a different form such as replacing the brake pads on an automobile.

As with the first two information literacy standards this standard could be taught in most disciplines and classes.

Art connections: Understands how elements, materials, technologies, artistic processes (*e.g.*, imagination, craftsmanship), and organizational principles (*e.g.*, unity and variety, repetition and contrast) are used in similar and distinctive ways in the various art forms (Kendall & Marzano, 1997, p. 381).

Foreign language: Uses verbal and written exchanges to gather and share personal data, information, and opinions (Kendall & Marzano, 1997, p. 498).

History understanding: Knows how to construct time lines of significant historical developments that mark at evenly spaced intervals the years, decades or centuries (Kendall & Marzano, 1997, p. 111).

Mathematics: Represents problem situations in and translates among oral, written, concrete, pictorial, and graphical (Kendall & Marzano, 1997, p. 47).

The first three standards describe the student who is information literate. The next six standards describe how the information literate student uses those skills.

Category II: Independent Learning

Standard 4:

The student who is an independent learner is information literate and pursues information related to personal interests. The student seeks information related to various dimensions of personal well being and evaluates information products related to personal interests. An example of this standard is a student planning a backpacking trip to Europe by collecting information on various sites to see along the way.

Theater: Identifies and researches cultural, historical, and symbolic clues in dramatic texts (Kendall & Marzano, 1997, p.402).

Behavioral studies: Understands how language, literature, the arts, architecture, other artifacts, traditions, beliefs, values, and behaviors contribute to the development and transmission of culture (Kendall & Marzano, 1997, p. 595).

Foreign language: Understands the main idea and themes, as well as some details, from diverse, authentic, abilityappropriate spoken media (e.g., radio, television, live presentation) on topics of personal interest or interest to peers in the target culture (Kendall & Marzano, 1997, p. 500).

This standard deals largely with factual and nonfiction information that is obtained by the students for their own personal interests.

Standard 5:

The student who is an independent learner is information literate and appreciates and enjoys literature and other creative expressions of information. The student is a selfmotivated reader who derives meaning from information and develops creative products in a variety of formats. The student might read, for pure enjoyment, an Anne Rice novel or a play by Shakespear.

Behavioral studies: Knows that language, stories, folktales, music, and artistic creations are expressions of culture (Kendall & Marzano, 1997, p.594).

Foreign language: Knows some basic expressive forms of the target culture (e.g., children's songs, simple selections from authentic children's literature, types of artwork or graphic representations enjoyed or produced by the peer group in the culture studied) (Kendall & Marzano, 1997, p. 503).

History: Understands how stories, legends, songs, ballads, games, and tall tales describe the environment, lifestyles, beliefs, and struggles of people in various regions of the country (Kendall & Marzano, 1997, p. 125).

In addition to regular classroom activities this standard might be achieved through activities such as a school-wide reading program or including a large collection of pleasure reading materials in the school media center.

Standard 6:

The student who is an independent learner is information literate and strives for excellence in information seeking and knowledge generation. The student is self-reflective by assessing the quality of the process of one's own information seeking and devises strategies for improving selfgenerated knowledge. An example of this is the student who transfers to a new college after the first year because the original school did not offer a particular major.

This standard is only covered indirectly by all traditional subject areas that are taught in K-12 schools.

English language arts: Identifies and defends research questions and topics that may be important in the future (Kendall & Marzano, 1997, p. 333).

Mathematics: Uses a variety of strategies to understand problem-solving situations and processes (e.g., considers different strategies and approaches to a problem, restates problem from various perspectives) (Kendall & Marzano, 1997, p. 47).

Science: Knows that scientific explanations must meet certain criteria to be considered valid (e.g., they must be consistent with experimental and observational evidence about nature, make accurate predictions about systems being studied, be logical, respect the rules of evidence, be open to criticism, report methods and procedures, make a commitment to making knowledge public) (Kendall & Marzano, 1997, p. 98-99).

Since this standard is not covered in other subject areas this is an open opportunity for the school media and technology specialists to teach this concept.

Category III: Social Responsibility

Standard 7:

The student who contributes positively to the learning community and to society is information literate and recognizes the importance of information to a democratic society. The student seeks information from diverse sources and respects the principle of equitable access to information. An example of this standard is a student defending the right of someone else to speak even though that student does not support the position.

Behavioral studies: Understands how the diverse elements that contribute to the development and transmission of culture (e.g., language, literature, the arts, traditions, beliefs, values, behavior patterns) function as an integrated whole (Kendall & Marzano, 1997, p. 595).

Civics: Knows some common forms of diversity in the United States (e.g., ethnic, racial, religious, class, linguistic, gender, national origin) (Kendall & Marzano, 1997, p. 432).

Civics: Knows some of the benefits of diversity (e.g., it fosters a variety of viewpoints, new ideas, and fresh ways of looking at and solving problems; it provides people with choices in the arts, music, literature, and sports; it helps

people appreciate cultural traditions and practices other than their own) (Kendall & Marzano, 1997, p.432).

History: Understands how individuals have worked to achieve the liberties and equality promised in the principles of American democracy and to improve the lives of people from many groups (e.g., Rosa Parks, Martin Luther King, Jr.; Soujourner Truth; Cesar Chavez) (Kendall & Marzano, 1997, p.121).

This is perhaps the most difficult standard to achieve in a K-12 setting but there are still many things that educators can do to help students understand the benefits diversity in a democratic society.

Standard 8:

The student who contributes positively to the learning community and to society is information literate and practices ethical behavior in regard to information and information technology. The student uses information technology responsibly respecting the principles of intellectual freedom and intellectual property rights. The student who has achieved this standard does not purposefully distort data to support a particular position and provides citations where appropriate.

Civics: Understands the sources, purposes, and functions of law and the importance of the rule of law for the protection of individual rights and the common good (Kendall & Marzano, 1997, p.417).

Science: Understands the ethical traditions associated with the scientific enterprise (e.g., commitment to peer review, truthful reporting about methods and outcomes if investigations, publication of the result of work) and that scientists who violate these traditions are censored by their peers (Kendall & Marzano, 1997, p.103).

This standard has major implications for the effective use of technology in schools.

Standard 9:

The student who contributes positively to the learning community and to society is information literate and participates effectively in groups to pursue and generate information. The student shares information with others, respects others' ideas acknowledging their contributions, collaborates with others, identifies information problems, and develops information products. An example of this standard is students working together in groups to solve a common problem.

Theater: Knows how varying collaborative efforts and artistic choices can affect the performance of informal and formal productions (Kendall & Marzano, 1997, p.402).

Behavioral studies: Understands that a variety of factors (e.g., belief systems, learned behavior patterns) contribute to the ways in which groups respond differently to their physical and social environments and to the wants and needs of their members (Kendall & Marzano, 1997, p. 594).

English language arts: Evaluates own and others' effectiveness in group discussions and in formal presentations (Kendall & Marzano, 1997, p. 345).

Geography: Knows the ways in which culture influences the perception of places and regions (Kendall & Marzano, 1997, p.518).

This standard can be taught in conjunction with programs such as drama, music, and athletics. Many activities in these subjects are built around groups that can be used as examples for other subject areas.

Conclusion

As the students of today face the enormous growth in information coupled with easier access to that information, schools must provide a new set of skills. These skills, as reflected in the nine Information Literacy Standards, will enable these students to effectively use this information for the greater good.

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Technology-Based Macrocontexts for Teaching Integrated Science and Language Arts

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This paper describes technology as a tool for creating macrocontexts for teaching integrated science and language arts. Since both science and language arts involve interrelated cognitive functions, integrating the two subjects would be an interesting way of teaching in elementary education (Krogh, 1995; Koballa, Jr., 1991; Caine & Caine, 1991). From a synthesis of literature Koballa, Jr. (1991) summarized that teaching science improves reading skills, reading readiness, written and oral communication skills, and also the development of language in students with disabilities. However, a study by Eldridge, Jr (1988) found that the emphasis on reading skills in science lessons remains very limited.

According to Yates and Chandler (1991) learning involves making conceptual changes in cognitive structure by placing new information in a mental network of prior information in a meaningful way. In order to achieve greater cognitive gain, learning must be meaningful. According to Ausubel's explanation of verbal learning (cited in Anderson & Pearson, 1984), learning becomes meaningful only when new ideas make relevant connections to known ideas already established in the cognitive structure of individuals. From this perspective the context of learning is critical, because knowledge is located (or situated) as a part of the context from which it is acquired (Brown, Collins, & Duguid, 1989).

Macrocontexts and Technology

Studies of contextualization by Brown, Palinscar, and Ambruster as well as Tharp (cited in Baker, & Brown, 1984) emphasized the importance of "essential strategies in the context of actually reading or studying with the goal of arriving at a coherent interpretation of the text" (p. 383). For example, integrating language arts with science provides those "essential strategies" in addition to augmenting the context of each content area. See Kumar and Voldrich (1994) for a report of literature-based macrocontexts for teaching science at the elementary grade level. Educational technology makes it possible to enrich contexts for the integration of science and language arts. Both science and language arts are areas which help students engage in learning cognitively. As discussed earlier in this paper, new information should be able to find a niche in the knowledge structure of the learner in order to be connected meaningfully to existing knowledge.

It should be pointed out that the kind of technology needed for the integration of science and language arts is not limited to specialized educational technology applications such as custom developed multimedia systems. In the age of information technology there are various resources such as videos and the World Wide Web (WWW) that can be used to create macrocontexts for teaching integrated science and language arts. Teachers can use several criteria for deciding what kind of technology-based resources to use for creating macrocontexts in teaching integrated science and language arts. It should be emphasized that the classroom teacher's level of confidence in science and language arts content and knowledge of technology-based resources are vital to making such innovative curriculum decisions. The following suggestions are a few steps that should guide teachers in this task:

1. The context chosen for integration must be available on videodisc, videotape, CD or World Wide Web (WWW).
2. The context must be appropriate for student viewing at the elementary levels.
3. The context must be rich in information needed to gain the attention and interest of students.
4. The context must contain explicit information in a language of communication familiar to students.
5. The science and language arts represented in the context must fall within a topic of inquiry in the school science and language curricula.
6. The teacher should be able to clearly identify the science concepts and language skills to be taught embedded in the context
7. The topic must be appropriate to the level of the students.

Applications

Videotapes. Reading Rainbow series is an excellent program on videotape that can be used to create macrocontexts for teaching integrated science and language

arts. The episode "Hill of Fire" (Liggett, 1985) was used in a fourth-grade Drop Out Prevention research project (Bristor, 1994; Bristor & Drake, 1994). After reading the text concerning volcanoes in their science books, the fourth graders watched the Reading Rainbow "Hill of Fire" segment. The following discussion included comparing the Kilauea Volcano in Hawaii to the Mexico volcano in "Hill of Fire" and comparing the science text with the graphic model in Reading Rainbow. Other activities could include the following (Schweiger, 1988): Ask students how can we learn more about the Paricutin Volcano, Kilauea Volcano, and other volcanoes; Ask students to identify what new information was in the program (Fumaroles, kinds of lava—aa and pahoehoe); Have students explore careers involving scientists who study volcanoes (Volcanologist) and instruments used to measure the intensity of volcanic eruption (Seismograph). Also, the fourth graders pretended to be on-the-scene reporters recounting the pertinent facts about the eruption. The students were delighted to hear that they would have the opportunity to read their news reports before a video camera. Even the children who were usually reluctant to write were excited about the assignment. One student combined his prior knowledge (facts concerning the event) as well as vocabulary words (such as "village," "abandoned," and "destroyed") learned from the video and book along with science concepts (how volcanoes are formed) from the science textbook to write the following "draft" of his news report.

On February 20th 1943 a farmer was plowing in Mexico. Then the plow got stuck in the earth [sic] crust and the earth began to shake. Then smoke came from the ground. A hill came up from the ground and shoting [sic] rocks from the ground. And the heat and the pressure formed a volcano. The volcano erupted and the volcano covered the village [sic] was destroyed. The people abanded [sic] their homes. No people were hurt but their homes were destroyed. Now 50 years later you can go see the volcano and the covered village [sic]" (Bristor, 1994, p. 35)

Other integrated science and language arts activities can include (Butzow & Butzow, 1989; Schweiger, 1988): Using the *World Almanac* find the list of active volcanoes in the world. Assign cooperative groups of students to investigate and research the different types of volcanoes from around the world, including information about how the volcanoes affect the people living nearby. Use pushpins or sticky dots to indicate the volcanoes' locations on a world map. Why is this arrangement of these volcanoes often called the "Ring of Fire?" In what area of the world are most of these volcanoes located? Have children create their own exploding volcano by using plaster and water according to package directions. Baking soda in the "crater" with a few drops of vinegar produces an "eruption"; Have children collect rocks and stones that can be used to create a stone sculpture; and Have children read fiction and nonfiction trade books related to the topic of volcanoes.

Videodiscs and CDs. Videodiscs and CD's serve as anchors for providing macrocontexts in which the learner can further explore learning across subject boundaries (Cognition and Technology Group at Vanderbilt, 1991; 1993). Take for example instruction using the *Raiders of the Lost Ark* videodisc described in the Cognition and Technology Group at Vanderbilt (1993). According to CTGV, students who participated in learning activities using this videodisc were successful in making spontaneous connections between classroom lessons and events or activities outside the classroom. That is, the videodisc anchor enabled students to "use standards (e.g., the height of Indiana Jones) to measure other objects (e.g., the width of the pit in the cave; the length of the airplane). They spontaneously attempted to use similar techniques to estimate the height of objects on the campus such as height of buildings, flagpoles and trees" (CTGV, 1993, p. 61). Such a popular movie should also lend itself to a variety of language activities including the comparison of spoken English among various cultures represented in the movie.

Another example of using videos for integrated instruction is found in the CTGV's (1993) report of the Young Sherlock project. In this project, the story of Sherlock Holmes was used to create a macrocontext for integrating language arts, scientific reasoning and history skills. According to CTGV (1993), "students discuss general principles for writing effective and coherent stories rather than focus only on the concrete story represented in the Young Sherlock video" (p. 56). Students were able to develop pattern recognition skills by noticing the wounds to the throat of the murder victims. In addition, they were able to transfer knowledge by applying vocabulary learned in the classroom to situations beyond the classroom and spontaneously create "coherent plot structures across multiple story writing activities" (p. 61).

The "Adventures of Jasper Woodbury" Series is another example of video-based integration. The Jasper Series (professionally made videodiscs of approximately 15 minutes in length) involves a series of adventures of a character named Jasper Woodbury. Each episode is embedded with data. The challenge to students is to understand the episodes and solve problems. For example, in a challenge involving a boat journey in the episode "Journey to Cedar Creek" students were to determine the speed of the boat. According to CTGV (1993), some teachers who used this episode in their classrooms "helped students construct and use charts that allowed them to determine how speeds defined as 'minutes to go one mile' translate into speed defined as 'miles per hour' (p. 55). This episode also provides visual clues for students to engage in writing activities describing a variety of characters, objects and places in the episode.

Additionally, students can explore related topics such as endangered species or principles of flight. Students can

write their own adventure story using the information in the embedded teaching episodes. For example, one embedded teaching episode contains information on how to use a compass and bearing guide, how to read a topographical map, and how to use the properties of an isosceles right triangle to estimate heights and widths. Students could incorporate this information into their stories. A discussion of the similarities and differences between the two adventures on a major topic will help students focus on general characteristics rather than specific details. After the solution is shown, students could compare their solutions with the ones on the video and evaluate the strengths and weaknesses of each approach. To assist community members in understanding what it is like to solve the kinds of complex problems that the students are working on, community leaders and parents could be invited to watch a Jasper adventure and accompany students on a field trip related to that topic within the community.

World Wide Web. Since the advent of the World Wide Web (WWW) the availability of curricular materials in science has exponentially increased. The WWW is perhaps the most reforming factor to happen to science education since the curriculum reform efforts of the late fifties and early sixties. There are a number of science education web sites suitable for integrating science and language arts. An example of a web site suitable for integrating science and language arts is the *Science Power 2000* (SP2000). The SP2000 web site provides a series of interesting science lesson plans on topics such as birds, blue sky, clouds, energy flow, solid waste, etc. This web site is not only a source for hands-on instructional activities but also a platform for teaching whole language approaches to reading. Other WWW resources that are suitable for textual as well as science curricular materials include the Cable News Network's (CNN) *Sci-Tech Main Page* which provides macrocontexts for engaging students in Science-Technology-Society approaches to learning and problem solving in science around real world issues and also provides opportunities for developing skills in reading and oral communication. There are other WWW science resources on the Internet. Using a "Search Engine" locating WWW resources suitable for teaching science that are also suitable for language arts should not be a difficult task for teachers. However, it is strongly recommend that teachers adhere to some guidelines similar to the "Resource Selection Guidelines for Integration" listed earlier in this paper.

Assessment and Conclusion

Assessment of integrated science and language arts learning situated in technology-based macrocontexts is an important task. Teachers should not rely solely on traditional memory recall and short-answer tests insensitive to contexts (McColskey & O'Sullivan, 1993; Wiggins, 1993). In context specific situations "what is wanted is a more robust and authentic construct of understanding" (Wiggins, 1993, p. 209). Students loose their "natural enthusiasm" for learning once they notice that the ultimate purpose of the macrocontext based integrated activity is to prepare them for another paper and pencil test to earn a grade. According to Krogh (1995) and Kumar and Voldrich (1994), teachers should plan for a variety of alternative ways to assess students' performance in integrated instructional situations. The alternative assessment may include formal and informal observations, anecdotal records, portfolios, and follow-up activities. Students should not be assessed for their mastery of technology use.

Technology offers great hope for integrated science and language arts instruction. As in any technology-based instructional situation, technological applications for creating macrocontexts must be justifiable based on the foundational theories and principles of education or they will not stand the test of time in education. It is hoped that teacher education programs will incorporate technology-based approaches to creating macrocontexts for teaching integrated science and language arts in their preservice and inservice programs.

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The Math, Science, & Manufacturing Collaborative

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The concept of a collaborative math and science project grew out of the needs expressed by university engineering faculty and junior and senior high school teachers. Cleveland State University (CSU) engineering faculty have faced declining enrollments in recent years and local teachers have expressed a concern that secondary students do not perceive math or science to be relevant to their career opportunities. As such, these groups sought to provide students with connections to "real world" situations that the students will face as they transition into the workplace of the future.

The driving force behind the math and science collaborative was the Advanced Manufacturing Center (AMC) located on the campus of Cleveland State University. AMC is an affiliate of the Cleveland Advanced Manufacturing Program (CAMP), an organization that addresses difficult engineering and manufacturing problems encountered by Northeast Ohio industries. From 1995 through 1997, the AMC conducted projects with over 70 regional manufacturing companies to improve manufacturing competitiveness. These projects provided hands-on learning experiences to over 90 undergraduate and graduate students. When compared with traditional students, the AMC engineers contend that students with hands-on experience gain a better understanding of engineering concepts. The underlying assumptions of the collaborative are that secondary teachers' understanding of engineering concepts will be enhanced by engaging in engineering problem solving and that the teachers will then incorporate lessons learned from the engineering experiences into their classroom teaching.

Other partners in the collaborative included the Colleges of Education and Engineering at Cleveland State University. The AMC and the CSU College of Education (COE) have collaborated on a variety of projects related to hands-on manufacturing education with Cleveland area high schools for several years.

The goals for the collaborative project were (a) to improve the quality of instruction provided to students, (b) to better prepare in-service teachers, (c) to increase understanding of educational barriers to curricular change, (d) to facilitate the exchange of information, and (e) to foster mutual respect among secondary school teachers and college/university faculty.

Project activities included awareness sessions, a model curriculum workshop, a summer industry experience for teachers with faculty in which curriculum materials were developed, a follow-up team teaching experience for teacher/faculty teams, and development of a monograph describing the project. Three areas of particular interest revolve around the inception of the project, the awareness sessions, the instructional support workshops, and the industry work experiences.

Awareness Sessions

Project staff spent March to June 1996 conducting awareness sessions with groups of teachers in the Westlake City School District, and representatives of other local school districts. The awareness sessions served as the first step in recruiting participants for the project. A schedule of one-hour awareness sessions were conducted and facilitated at a variety of sites by representatives of the collaborative partners. An overview of the project and the goals were presented to prospective participants. A reaction questionnaire distributed to teacher participants was used to evaluate the outcomes of the awareness sessions. Open ended questions such as; "From a teacher's point of view, if I were organizing a program like this one, I would: (be creative)" were included as well as multiple choice questions related to the utility of the collaborative for developing curricular materials. The questionnaires provided the project staff with information to determine reasons for teacher interest in the program and barriers to attending the program so that this information might be incorporated in planning for future efforts.

Participants identified five major reasons for program interest:

1. The project is connected to "Real Life";
2. Students will "turn on" when provided with unique experiences;
3. Teachers will be able to give students marketable skills;
4. Teachers will be able to show students the relevance of math and science to the real world and careers;
5. Projects and "hands-on" activities are important in preparing students with marketable skills.

In order to define the concerns, goals and activities that met the common educational concerns of the different

partners, five focus group meetings convened among the AMC, COE, Greater Cleveland Educational Development Center, Westlake City and Elyria School districts (teachers and administrators). The focus group participants identified several common educational concerns:

- fewer students interested in pursuing math, science, and engineering careers,
- the need to address multiple intelligence and various learning styles,
- the need to adopt methods that teach the conceptual requirements of the Ohio model curriculum,
- the need to increase the tools available to teachers that enhance teaching in an applied method,
- the need to supplement teacher's expertise of technology skills required in a modern workplace, and
- the need to develop new curriculum and methods to prepare pre-service and in-service teachers.

The awareness groups also defined several needs of the teachers. Primary among these needs was experience working in business and industry. This leads to difficulty in redesigning curriculum to appropriately reflect "real world" applications. Some also reported a lack of awareness of the broad scope of career opportunities that are available to students who wish to pursue science, mathematics, and engineering degrees. Another need identified by some teachers was a better understanding of how to incorporate teaching methods that address diverse learning styles and multiple intelligence. Most teacher participants understand these concepts but indicated that they were uncomfortable developing appropriate classroom activities to address them. University faculty indicated that they are frequently critical of the elementary and secondary educational systems because students increasingly come to higher education unprepared for college level work. However, the same faculty admitted that they knew little about the problems that teachers encounter especially in the areas of secondary math and science instruction. The different participants agreed that an ongoing forum to foster mutual understanding among faculty and teachers was needed.

Instructional Workshops

One component of the project was planned to provide participant teachers with a series of instructional workshops prior to a "Summer Industry Experience". Workshops addressed the following topics: secondary science and mathematics standards, cooperative learning, simulations, problem-centered learning, and inquiry-based learning. Participating teachers completed a questionnaire at the end of a three-day workshop. The information collected from the questionnaires was used to help the project staff evaluate the workshop effectiveness and to incorporate modifications to the project.

Seventy-two percent (23 out of 32) of the teachers completed the post workshop questionnaires. The questionnaires provided opportunities for the teachers to respond to issues regarding the usefulness of the instruction, the quality of the instructional materials presented, familiarity with the methods employed and the quality of the instructors. In general, the teachers responded favorably to the instructional workshops. The information collected from the questionnaires indicates that most of the teachers were responsive to the materials covered in the workshops. However, answers to the open ended questions suggested that the teachers were confused about project direction early on in the process. Statements such as, "lack of direction about individual projects- no idea how to select a project", "I still feel lost. I don't think enough time was spent discussing our individual projects", and " the product is still not clear to me, hopefully this will be clarified as time goes on", indicate that the teachers, though enthused about the project were not clear about the direction. One possibility for the lack of comfort may have been related to the order of activities in the instructional workshops. The workshop curriculum activities were conducted prior to teacher discussion of possible projects with the engineering faculty. As such, the teachers were unclear as to what their responsibilities would be once they began the third phase, the summer engineering experience. Most activities in the instructional workshops were highly structured to cover the different curricular topics. The result was that few opportunities were provided for teachers to discuss the actual summer engineering activities with the faculty. Additionally, faculty attendance became increasingly erratic as the workshops progressed, reducing further the opportunity for interaction between the teachers and the engineering faculty. The result was that decisions regarding the selection of a summer engineering internship were postponed until the last minute. In general, a teacher's decision to work on one project versus another was not well informed.

In summary, some teachers indicated the workshops provided a good review and they were open to finding out more about the curriculum that they had committed to produce for the project. However by the close of the instructional workshops the teachers appeared somewhat confused about the next step - the summer industry work experience.

Summer Industry Work Experience

The teacher and faculty participants collaborated on 15 different engineering projects during the summer. Typical group size consisted of 1 engineer paired with 2 - 3 teachers. The purpose of the work experience was to provide the teachers with a context for understanding how engineers solve problems so that the teachers could then use this experience to develop curricular materials reflecting similar types of problem solving. Problem solving issues embedded in the projects revolved around Computer Science (hardware and software), Industrial Engineering, Mechanical Engineering, Chemical Engineering, and Civil Engineering.

All of the projects required working with a variety of software and hardware engineering tools. Most of the teacher participants were unfamiliar with the engineering tools at the outset of the summer work experience. The teachers were required to commit 120 hours on the industry work experience.

Teachers and faculty were asked to give the project staff feedback on their "Summer Industry Work Experience." A questionnaire was mailed to participants in August of 1996. Participants were asked a series of questions related to their work project.

Three major themes surfaced from the teacher surveys of the industry work experience: Project Planning and Preparation, Highlights of the Learning Experience, and New Ideas for the Project's Future.

Project Planning and Preparation

Teachers and faculty alike seemed uncomfortable with the perceived lack of information about the project at the onset and throughout the summer. Several possible issues may have contributed to this lack of comfort.

First, although the engineers had collaborated on industrial projects with manufacturing personnel this was the first opportunity for them to work with secondary teachers. Despite considerable project planning, meetings and revisions not all variables were foreseen. In particular, neither group was clear on how to achieve the goal of integrating the engineering experiences into instruction. In addition, it took time to learn what aspects of the project worked and what aspects did not. A formative report on the summer phase of project was completed after the work experience. Thus, by the time potential revisions were identified, it was too late to implement them into the summer experience.

Second, many of the teacher candidates who had expressed interest during the awareness sessions had already committed to other projects during the summer before notification of funding for the project occurred. Time was passing and the need to recruit teachers was immediate. As such, many of the newly recruited teachers had not attended the awareness sessions and did not fully understand the scope and purpose of the collaboration. Additional time was needed to clarify the purpose of the summer experience to both the engineering faculty and the participant teachers.

Third, the project was unable to hire a coordinator until after funding was secured. As such, much of the initial process of recruitment, interviewing and selecting a coordinator were occurring at a time when information critical to understanding the purpose of the project needed to be disseminated to potential participants. Engineering faculty were recruited by the Project Administrator. Most of the communication between the administrator and the faculty was oral and some of the engineers were not clear about the scope of the project or their role in it. The project brochures provided to teachers outlined the basics aspects of the program but additional detail on specifics was required.

In summary, further explanation and preparation of faculty and teachers was required in the planning phase of the project. Once the summer industry work experience were underway participants were able to work out most of the problems that confronted them but it would have been better if all parties knew what to expect from the other at the outset.

Highlights of the Learning Experience

The three basic components of the learning experience were to provide the teachers with (a) fifteen flexible days to work on complex projects developed by the engineering faculty and AMC staff at the AMC or an industrial site, (b) five flexible days for developing curriculum relevant to the teacher's curricular goals, and (c) five days for advanced training in an area of interest. All three components were implemented and comments by the teachers help explain what worked well and what might be improved.

The "loose structure" of the summer experiences made the program expectations somewhat vague but also provided freedom for the participants to explore and develop areas of personal interest. Many of the participants noted that engineering involves a great deal of problem solving and that these problems are solved cooperatively and that it takes considerable time and creativity to solve problems. Other participants learned that communication plays an important role in engineering. Knowledge of an idea is insufficient if you cannot communicate the idea to others.

One comment by a participant " I learned that teachers can bring industry/manufacturing into the classroom and train students to have skills for the 'real world'." provided support to the original goal of encouraging teacher participants to create curricular materials that reflect the problem solving approach used by engineers.

Ideas for the Project's Future

The teachers, in their questionnaire comments, offered many ideas. Many of these comments revolved around the practical constraints of applying the ideas embedded in the summer work experience in the classroom. Primary among the suggestions was the need to consider how the engineering and manufacturing experiences might be applied to the computers available in the local schools. Computer classes and equipment are required to accomplish specific tasks and both the classes and the equipment should be offered to the teachers prior to the industry work experience, so that the teachers are more adept with the technology before they become involved in a project.

Time or lack of it appeared as an important issue to the teacher participants. Several indicated that providing informal time for teachers to discuss issues such as curriculum development was critical for meaningful integration of activities in the classroom. The teachers also suggested that

the engineering faculty might benefit from opportunities to learn basic principles of teaching and learning.

Conclusion

This report was an informal assessment of the math, science and manufacturing collaborative. It was an attempt to reflect on the experiences of the participants based on their responses to a series of simple questionnaires. Although the preliminary findings are generally favorable it is too early to generalize this experience to other projects.

What is interesting about the questionnaire feedback is that this feedback does not merely state the problem but frequently includes suggestions for how the project might remedy the problem in the future. Based on the questionnaire responses it was clear that many of the teachers had developed a commitment to the project from their summer work experience. Information is currently being collected from the teachers, faculty and project administrators via in depth interviews. The interviews should provide additional information regarding the efficacy of the project.

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Technology Guides for Teacher Education at MSU

Andrew Topper
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MSU has been working for several years to incorporate technology into the teacher preparation program. The state of Michigan requires that all student teachers be competent with technology, so MSU has an obligation to ensure that its students meet these legal requirements. The college of education has taken steps to infuse technology into the teacher education program by helping faculty and students use the technology, establishing the Technology Exploration Center for faculty and students in Erickson Hall, hiring technology coaches (previously known as technology mentors) to support faculty and students' use of technology, and hiring faculty with extensive technology experience.

A variety of methods have been used to help educate staff and support innovative uses of technology within the college. In 1997, a new approach is being tested to support technology integration within the MSU teacher education program. Instead of directly supporting students in the TE program, a group of technology guides are supporting instructors who are teaching common courses in the teacher preparation program. These include TE301, TE401, TE402, TE801, and TE813, and represent the largest portion of subject matter specific classes in the TE program. This change in focus, from supporting the TE undergraduate students to supporting TE instructors, represents an important change in our philosophy with regard to our plans to prepare future teachers for adaptive and pedagogical uses of technology.

Toward this end, technology guides provide a variety of services including technology workshops, one-on-one instructor consulting, establishing Web-based resources, setting up and moderating discussion lists, publishing newsletters, and showcasing exemplary uses of technology within the college. An effort has been made to encourage and support innovative uses of technology in teaching within the TE program so that prospective teachers can observe, examine, and discuss models of teaching with technology as they move through their undergraduate program.

Goals for the technology guides are to:

- Foster and facilitate TE instructors' use of technology within the teacher preparation program
- Support faculty uses of technology in teaching
- Showcase exemplary uses of teaching with technology
- Develop and support virtual communities within and around the teacher education program based on domains of interest
- Conduct research on technology adoption within the MSU teacher education program
- Support and monitor TE students progress towards technology requirements

History of technology adoption at the MSU College of Education

In the 1992 the MSU Department of Teacher Education formed a working committee to explore possible solutions to the challenge of exposing preservice teachers to technology. The committee was composed of faculty who had interests in teacher education and technology and who taught in the teacher preparation programs. Faculty in the MSU teacher education program decided that technology would only have an impact on education when teachers saw and used it in the same way they used libraries, textbooks, blackboards, pencils, and paper.

From a pragmatic perspective, MSU teacher education faculty members ran into several constraints on their efforts to implement a technology component in the teacher preparation program. First and foremost, were issues of autonomy and control each of the preparation teams had over the program. Initially, technology education was to occur within two hours of class time each week and was to be provided by faculty or staff from each team. This made the goal of embedding technology in curricular contexts very difficult and resulted in a focus on of a small set of generic tools which could be used in a variety of educational settings instead of a contextual technology use approach.

As a result of these constraints, little attention was paid to curricular-specific technology. A change in focus also occurred when necessary funding for faculty training and support was not forthcoming in the second year of the program. This led to a perception within the teacher preparation program, both on the part of faculty and students, of technology as an additional task and not an integral part of learning to teach.

Later, technology coaches (also called mentors) were hired by the college to support students learning to use technology and to assess their technological proficiency in five areas: e-mail, Internet, word processing and presentations, database and spreadsheet, and subject-area software.

Technology projects at MSU

Within the college there are a variety of ongoing research projects, that have used technology in teaching and learning. Examples include the MathLab project, the Learning Exchange for Teachers and Students through the InterNet (LETSNet), the Center for Advanced Learning Systems, the Technology Challenge Grant, the Institute for Research on Teaching & Learning Across the Life Span, the Technology Enhanced Learning Environment, and the Reading Classroom Explorer. [Note: All of these projects are described on the College of Education website.]

While these projects have focused on specific aspects of teaching and learning with technology and on research, they have not been used extensively within the college as resources for teacher preparation. The college is still trying to determine how the outcomes from these various technology research projects can be incorporated into the teacher preparation program.

For example, technology guides work with TE instructors to determine how the technology projects might be helpful for prospective teachers. In the case of some projects, such as the MathLab and LETSNet, there are valuable examples or models of teaching with technology now available to TE instructors and their students. Making TE instructors and students aware of these resources is an important part of what technology guides and TE instructors accomplish together.

Teacher Education Course Instructors

Within the Teacher Education (TE) program in the MSU college of education, graduate students in the TE Ph.D. program teach many of the core teacher preparation courses. While many of these students have extensive experience in K-12 classrooms, most of them have not taught classes at the college level or used technology in support of their teaching.

Some faculty members in the college of education also teach undergraduate teacher preparation classes. Most of these faculty members have little background or experience incorporating technology into their own teaching practices. While prior attempts to integrate technology into the TE program have focused on undergraduate students, we felt that providing support for TE instructors would represent a better long-term strategy for the college.

We believe that until TE instructors regularly use technology in their teaching, TE students will not understand or appreciate how technology can be integrated into teaching subject matter. Seeing their instructors use technology will provide TE students with real-world examples of teaching with technology and will hopefully stimulate ongoing discussions about the role of technology in educational at all levels. We realize that this process of technology adoption at the college level may take some time, but we strongly believe it is essential to preparing future K-12 teachers for their own technology uses.

Technology guides, working with TE instructors, have developed a Web-based technology proficiency resource that includes a self-assessment that teacher education students can use to measure their progress towards technology proficiency. See http://rorschach.educ.msu.edu/TechReq/techrequirements.html. The on-line resource also includes a description of the technology requirements, a rationale for these requirements, and examples of how these requirements can be met. Currently, the MSU standards for teacher proficiency with technology call for simple or functional use of the four of the five areas suggested above, as well as one case of pedagogical or adaptive technology use.

Working with TE instructors, technology guides can help ensure that graduates of the MSU teacher education program have satisfied the state requirements for technology proficiency and support instructor use of technology in their regular teaching practices.

Role of the technology guides

Ongoing work for technology guides includes (a) creating and moderating a discussion list for the participants so they can have their questions answered throughout the year; and (b) creating a web page for the TE technology program with photographs of all technology guides and links to their home pages, to exemplary courses on the Web, to TE instructor web pages, and to supportive resources.

Duties for technology guides throughout the term include teaching 90-minute workshops, identifying tips of the day, identifying and showcasing exemplary uses of technology, working collaboratively with TE instructors, and monitoring student completion of technology requirements. Several technology guides are also responsible for supporting specific technology projects by incorporating the use of laptop computers into the TE internship program.

The principal role for technology guides is to support TE instructors as they work to incorporate technology into their TE classes. For those TE instructors who are not yet ready or willing to integrate technology into their teaching, technology guides also provide support to their TE students in accordance with the state mandate for technology competency.

There are a variety of benefits to using this approach including:

- More contact between TE instructors and the technology guides
- A jointly created body of knowledge about how to teach these courses

- Instructors develop their own practices and ways to teach the courses using technology
- Establishment of relationships between technology guides and Teacher Education teams
- Supporting virtual communities across physical boundaries
- Storing and passing on TE course materials among TAs
- Opportunities for TE instructors to engage in research practicum projects by studying their own teaching (practicum requirement)

Research component

As part of this effort, we are also building an infrastructure to support instruction with technology within the MSU Teacher Education program. We will do this by encouraging creation of a social support network for thinking about technology and opportunities to discuss the impact of technology on teaching. Key to this approach is the view of technology as a culture, not a subject, and a focus on content - teaching subject matter with technology, rather than a team-focused approach.

There are opportunities to collect data including interviews with people in the TE program, including students, faculty members, and instructors. For example, observing the instructors in the classroom as a basis for follow-up - using a guided practice approach; archive conversations: how do you teach with technology; multiple perspectives, etc.

In addition, some student teachers (student teachers or interns) in Detroit, Flint, and other outlying areas will be given PowerBooks to use in the field. These PowerBooks are meant to facilitate communication within the triads - interns, collaborating teachers, and field instructors - given the difficulty of meeting regularly face-to-face throughout the term.

Technology guides also work with the field instructors, interns, and collaborative teachers (triads) on fostering these communications over e-mail and supporting these people in the field. In addition, some of the participating interns and collaborating teachers were invited to take part in TE301/401/801 class discussions and assignments.

Supporting TE instructors

Each technology guide has been assigned to contact and offer support to a set of TE instructors. Some of these instructors welcome the help and support offered by the technology guides, while others are ambivalent or unready to consider how they might incorporate technology into their teaching. This is a similar problem faced by many technology advocates in K-12 schools.

When TE instructors do agree to work collaboratively with technology guides to bring technology into their courses, the results can be very impressive and lead to learning on the part of both the instructor and the technology guide. The examples described below are a few of the kinds of experiences technology guides have had working collaboratively with TE instructors.

Secondary Science TE401: Using e-mail and a spreadsheet

Deb Smith teaches a section of TE401 for secondary science majors and used two of her class sessions to demonstrate how her students could use technology: e-mail, with attachments, sent to her; and a spreadsheet, to collect and analyze data and generate a graph. Deb Smith wrote about her experiences in the computer lab:

> There were the usual server crashes, disk problems, etc. — mostly because when we made the Eudora disks originally, Yong came in and used his account, remember? So, many of their disks apparently had Yong's email address on them, and when they tried to sign on, of course the machine wanted his password. But we got that straightened out, with Deepak's and Tim Smith's help, and several other TEC guides who came over for short periods of time to help us.
>
> I think the seniors were intrigued by the possibilities that Clarisworks showed them for spreadsheet representaions, and played around a lot of different graphs and charts. And my in box is full of email and attachments from them today, so I'd say that they all accomplished getting that checked off! :)
>
> Thanks for your continuing support and help, both in helping me learn new things and in making it possible for my students to do the same.

These comments show that Deb is now feeling more comfortable with technology herself, is especially grateful for the support she gets from the technology guides, feels she has learned a lot, and is also confident she is helping her students learned and meet the technology requirements.

Elementary Social Studies TE401: Collecting Primary Sources for Social Studies

[URL=http://rorschach.educ.msu.edu/TechReq/TE401_9/]

Lynn Brice and Tim Smith developed a database assignment for Lynn's TE401 class (Section 9, Fall 1997) where their students helped construct a database to organize their annotated bibliographies of useful social studies references.

These references were collected from a variety of sources, including books and the World Wide Web (WWW), and gathered into a single database for distribution to all students in class. The students met in the Mac lab (EH132) and learned about databases, designed the database for the annotated references, and used the Web to locate potential references.

Tim created a document describing databases and how to create them in ClarisWorks 4.0. Lynn used this assignment to help her students satisfy the database technology requirement (simple or fundamental use) as well as optionally to satisfy the e-mail and Web requirement (simple or fundamental use). Students could e-mail their Web book-

marks or database entries to Lynn or Tim, satisfying the e-mail requirement as well as the Web requirement.

Conclusion

While the MSU College of Education has taken small steps towards integrating technology into the teacher education program, we believe we have made great strides this year and our approach will eventually prove successful in the long term. We fully expect to modify our approach, especially the way we implement various aspects of the support we provide for TE instructors and faculty, as we gather more information and evaluate the success of these activities.

We also realize that this process of technology adoption may ultimately result in fundamental changes in the way we prepare future teachers within the college of education and as such may represent a 10-year program of change. This represents a challenge to all of us in the college, students and faculty included. We are hiring new technology-savvy faculty members who we believe will help us in these efforts and we expect to continue to lead the country in the use of technology in teacher education. It is through these efforts that we believe we will see our graduating teachers themselves begin to use technology in innovative and transformative ways.

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A Statistics Class Website: Distance Learning on the Internet

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This research team is composed of two technology education graduate students, who will serve as Web developers, and their client, the professor for Political Science 801 and 802. The main goal of the project is to provide a supplementary educational aid to the client through the use of web-based tutorials and applied social constructivist approach in distance learning. The research examines how this approach accommodates and improves student performance.

The Problem

When social science students try to solve statistics problems, there are two major problems that they often face. The first is "how do I get the machine to give me results that I want." The "machine" is often the computer, but for many it is even their scientific calculators. Many social science students do not like math (as a student once put it: "I went into political science so I could avoid equations"). As a result, they tend to shy away from the subject whenever possible. They have a basic competency in the subject because of high school math requirements, but it often ends there. As a result, they are also not familiar with computational technology. For example, in Political Science 801 at Michigan State University, when presented with an explanation of factorials and told that this can more easily be found using the n! (or x!) button on their calculators, the students' eyes light up because now they finally know what that little button does. Another example would be students' recent revelation of how to find the value e^x (read "e raised to the x power") on their calculators. When this was demonstrated in class, the room was literally abuzz.

Even if they are familiar with computers and calculators, there is another, often more difficult problem for students to overcome as they learn statistics. That difficulty is one of problem identification, although it comes in several forms. Since there are so many different techniques available to use in statistics, students often don't know which to use. This is particularly confusing when the teacher demonstrates that there are often multiple ways of solving a problem - all of which lead to the same answer. Precisely because statistics is as much an art as it is a science, students need practice in recognizing which methods and approaches are most applicable to a particular problem. They also need training in converting a story problem into something they can handle as statisticians.

To do this, they must (a) be able to classify the problem and place it in one of the major categories of statistics problems. After that, they need to (b) be able to decompose the problem so that they can extract all of the relevant information from it. Following that, they would then (c) execute the appropriate method(s) to find the solution. This last stage is often the easiest, it is the first two that cause students the most problems.

Textbooks are often less than helpful in dealing with steps (a) and (b) because exercises are often placed at the end (or within) the chapters which cover the relevant material. The result is the student doing just the textbook problems rarely gets much insight on (a) since it doesn't take a genius to figure out that problems at the end of the binomial distribution chapter probably can be classified as binomial distribution problems. In addition, textbook type problems often give the students exactly the information they need to solve the problem in an easily digestible format, hence hurting their practice on step (b). In contrast, some of the exam problems are more reflective of the real world because there is either irrelevant information included or subtlety in the way the information is presented. What textbook problems are really good at is helping a student with the mechanics (c). Not surprisingly, students often state that once they work a problem past the (a) and (b) point, they can figure it out from there.

Because the issue of problem identification is harder to address using traditional methods and affects a larger percentage of students, it is this problem that needs to be addressed first. The problem of students' unfamiliarity with "machine" usage will naturally be mitigated with time as they use more computer-based learning.

Ideal Solutions to the problem:

1. The ideal would be to have a data bank of 100 plus questions from which the computer randomly draws to create a 10-question test for the student. This primarily

works on improving and diagnosing deficiencies in step (a). Taking this little test would identify a student who is weak in the ability to recognize and classify (and thus solve) certain types of problems and then send that student off to a review section which may be helpful. This wouldn't cover every area in every test, but it would give the student an opportunity to retake the test many times as they try to learn this material. Also, if students were able to see and comment on other student's work on the Internet, they could help each other learn through the process of social constructivist learning.

2. A chat room for group studies would be ideal. Students working together in study groups can learn effectively, but some of our students (particularly MPA students) live quite a distance from Lansing and commute for classes. Commuting for study group time is harder and as a result, these long-distance students either try to get in a group which meets directly after class or skip study groups altogether. Study groups have always been ad hoc, but with a chat room, it could be more structured in terms of time and participation and give more students the opportunity to participate. The professor and the TA have committed to being available in the chat room at certain times, to answer any questions students have.
3. Get old midterm and final exam questions on the web. This is useful, but old copies of exams (and their solutions) have been floating around graduate student circles for quite some time. This information is already available for many students now through unofficial channels. However, not all students, particularly those who have less contact with campus peers, have access to these old exams. The web site would make this access more legitimate and increase the circulation.
4. Place some tutorial information related to the course on the web site. It would be helpful to have expanded information on some of the more difficult statistics concepts taught in class.
5. Post class documents on the site. This site serves mainly as an information center for office hours and course requirements, which the students already have, but may misplace later in the term.

Technology and Limitations

As developers, we found some limitations with using Internet technology, first because the technology itself is in its infancy, and second, because many school computer labs are not yet fully equipped to accommodate what net-based technology can offer. Below are examples that illustrate this point:

1) Ideally, we would like a program that asks a statistics question, then provides a wide, blank space for the students to write out the solutions. Such a program would allow the students to enter the statistical solutions into the answer bank so that others can see their process of solving the problems. However, due to the limitations of html compatibility with math symbols such as pi and lambda, this is not a practical route.

Entering statistics symbols into a website is a function that is still in its infancy in html-based environments. Thus, the best way to enter math symbols such as pi and lambda is by typing it in a word processing program, copying and pasting it into a graphics program and then saving it as a gif or jpeg file. The final step then would be to paste it into the correct designated answer slot into the webpage. This means that all students in Political Science 801 would need to know how to type math symbols, load this text into a graphics program, save it as a file compatible with html, and then load it onto a webpage.

Presently the questions are entered manually in multiple choice form and eWeb provides ready feedback. We are able to type in the feedback to the student by typing symbols out in alpha numeric form, for example, "Your answer is incorrect, the correct answer is c, 2pi X .004; please study Normal Diatribution in the teaching center or the text."

2) When Professor Heimann requested a section to show students how to operate certain functions of SPSS, a program his students are using for assignments, the developers wanted to create a video of the professor explaining how to use SPSS and load it onto the website for all students to access. The problem is that even if we use video streaming, and our computers could accommodate a large file, the students use machines that are not compatible with this type of technology, and the students may not know how to download plugins for sound and video.

Actual Solution Outcomes

According to the proposed solutions above, the developers set up the following sites:

- *Document center*: This webpage contains a syllabus with class office hours, course requirements and meeting times.
- *Virtual Study Center*: This center is composed of eWeb, a virtual learning center. Multiple-choice textbook exercises are entered into the Testing/Exercises function of eWeb. Students can use the Forum and the Chat Room in this site to conduct on-line discussion about questions and problems that occurred in class or in the textbook exercises. The purpose of this site is to foster social constructivist learning by using communication technologies over the Internet. Our theory is that as students use the social interactive components of eWeb, such as the Forum and the Chat Room, their prior knowledge will change through the process of challenge and negotiation.

- *Testing Center*: This center stores old exams, class-assigned problem sets, and solutions to textbook exercises posted in the cWeb. The main purpose of this center is to equalize the distribution of old exams that are usually passed from friend to friend in inner circles. Students who are not a part of such a circulation can now access the old exams through this site.
- *Surfing Center*: contains WWW information and links related to statistics so students can expand their understanding from various cyber resources.
- *Teaching Center*: contains demonstrations and explanations about statistics concepts and related topics with color and explicit graphics and diagrams.

Process of Setting up the Project

First, the developers explained the Internet's utilities and developer's capabilities. The developers stated that their ability included setting up interactive web technologies. It was stressed that this website should not be set up for the sake of show and tell, but had to serve a specific need, a need that only the Internet could fulfill.

There were numerous conversations between the client and the developers during the development of the web site for this class, most of them over e-mail. The developers asked the professor (client) what the existing problems were for this course; and what the client expected to achieve through applying technology in his class.

Dr. Heimann clearly stated that he wanted to use this technology as a supplementary tool to his class, and not the main teaching tool. With all the information that the developers collected from the client, they informed the professor what educational technology could do to help him improve his teaching, while constantly assessing the methods that should be used to meet his needs. Fortunately, Dr. Heimann was familiar with Internet technology, making the planning stage very accommodating.

Reflections of the Developers

Working as a team of developers, we noticed that good communication is a necessary dimension of working with computer based technology. Technology tends to change the way we work. We cannot work on projects by ourselves; we have to depend on other's expertise and reliability. Thus, one's success does not merely depend on making a machine work, but also on how one engineers human interrelationships while doing so. During our project, the latter component was more unpredictable than the former.

Working with our client was easier than expected, but still a long process. The death of a member of Dr. Heimann's family was an unpredictable occurrence that discontinued the newly established communication rapport. As Dr. Heimann stopped answering our e-mail, we began to assume the scheduling of our project: Should the Problem Sets go in now, or at the end? We assumed at the end since each Problem Set was dated. We were wrong.

In fact, what we found was that communication between the client and the developer was such an integral part of this project that our every question had to be posed to and answered by Dr. Heimann. Coordinating the times that tests were to be entered was critical in helping students use the Website. Had we assumed that students would know the answers to the textbook questions before the last month of the term, the textbook questions would have been entered much earlier.

Moreover, when we set up a page and told Dr. Heimann, he did not respond right away by telling his students. It was as though we had to prove our work and ourselves before he would announce it to the class. Dr. Heimann's enthusiasm did not peak until we showed the product, in person, and explained the various webpages' functions.

At other times, Dr. Heimann would tell his students, but the students would not respond right away by going to the Website. This slow acculturation to new technology was perhaps due to three reasons: 1) They were unfamiliar with how the Website worked—although we offered to set up a tutorial session—and did not want to try to figure it out because they were already dealing with something new: statistics. Perhaps the researchers were right (Marchionini & Liebscher, 1991) when they found that people "have a tendency to try to lighten their cognitive load as much as possible." Not until the finals neared, and Dr. Heimann encouraged them to take the textbook exercises, did the students begin to do so. 2) A few students did try the site and got confused by going into the Testing page and finding a link to a Purdue testing package (this was an error caused by miscommunication between the members of the team of developers). Once betrayed by technology, people are reluctant try it again. It was interesting to observe that at times even we, as developers tended to put something off if it did not work for us right away. Similarly, Dr. Heimann would not tell us something was not working, unless we asked him how things were going. Perhaps he did this not to embarrass us, or perhaps he, too, put things off if they were not working. 3) The nature of the Internet allows for unaccountability. The students are not required to go to the website and there's very little the professor can do to enforce this. The website is not like a piece of paper that has to be handed in. A prime example of this is the survey we put on the website. We decided that if we passed out the survey on paper during class time, students would be made to do it on the spot. In contrast, the survey on the website may remain untouched, since it is an anonymous survey.

Research component

As a part of this research, we will evaluate the effectiveness, acceptability and affordability of the website as a study aid for Political Science 801 and 802. In evaluating the effectiveness, we will compare the data of student performance from the last five years —in which no such study aid existed, to this year's data—in which students used the

website for two terms. To assess acceptability, we will survey the students as to how much they used the website and how much the website helped them. We will also ask for student's opinion of what can be changed or added to facilitate their needs better. We will determine whether their comfort levels with "machines" have risen as a result. To evaluate affordability, we will compare this study aid with another similar type of study aid, the CD-ROM.

What we expect to find

Thus far the professor feels very confident that the student's performance will improve as a result of using the website. He notes the following:

> "I have my teaching assistant and myself log on to the chat room at designated times four times a week. This is great for students who live far away and can't come to office hours. Also, if another student asks me a similar or the same question as was discussed on the eWeb, I can tell them to go back and check out the transcript dialogue files in the chat room."

This is an example of technology adaptation that is purely utilitarian in nature. The class passes through three stages. Both the students and the professor first try to figure out the mechanics of using the website. Then they begin to adapt to the technology to suit their needs. Lastly, they begin looking for other ways to utilize this given technology. We expect Dr. Heimann to adapt other functions of the website to better suit his teaching needs as he realizes more of its potential. For example, the testing and exercises site will eventually coincide with actual class lectures. Presently, there is little coordination in this area.

We also expect the students to become more comfortable using this type of technology and thus the computer. The result will be circular. The more they use the site, the more they will become familiar with how the site can help them, and thus the more they will use the Website. We expect student motivation to rise as they become more familiar with the site.

The difficulty students have in identifying and distinguishing various types of statistics problems should be mitigated as students began to use the testing site more. We expect the final data to show that student performance this year has improved in comparison to the past five years.

Conclusions

Social science students are often bewildered in the area of statistics; they are exploring an unfamiliar realm when it comes to technology and math. We hope to mitigate their fears of both areas by setting up a study aid on the Internet. The main result we hope to achieve is twofold: 1) to fulfill the missing component of what the classroom text does not provide—the generation of problems in mixed order, so that students can learn to distinguish from the various types of problems and 2) provide a communication tool for social constructivist learning over long distances. The study will be ongoing for the duration of Political Science 801, and 802, 1997-98.

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An Integrated Approach to Computer Education for K-12 Teachers

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Increasing numbers of computers have become available to teachers and students in classrooms and computer labs through recent efforts at the national, state, and school district levels. Although most schools now have computers available, the use of computers as an instructional aid is limited (U.S. Congress, Office of Technology Assessment, 1995). Berry (1994) reports that teachers often do not see the value of computer use as a teaching and learning tool, and that 67% of Chicago Public School teachers said that computers wasted students' time. Bosch (1993) also reports that "some teachers suggest that the computer is a separate and specific learning experience apart from the general classroom (p. 8)." This paper reports on a project to combine two models for teaching computer-based instruction to student and professional teachers into a single integrated method. The models used in this project are the Instructional Technology Integration Model (Breithaupt, 1997) and the ABCD Model (Smith-Gratto & Blackburn, 1997).

The Instructional Technology Integration Model

A major component of the Instructional Technology Integration Model is focused on preservice education for student teachers and includes university classroom and field-based instruction and experiences. This model is part of the Collaborative Curriculum Development effort at a large private university, and takes advantage of the structure of school-university partnerships to facilitate and enhance student and professional teachers' efforts to use computer technology to support their curriculum.

Student teachers are required to complete an introductory core computer course in which they are introduced to computer operations and use, software evaluation and selection, and authoring systems. They are then required, as part of their teaching methods course, to complete an instructional computer program which supports a lesson plan from their proposed curriculum. Finally, for their student teaching practicum, they are paired with interested professional teachers and collaboratively develop computer-based instruction to support their curriculum in the professional teacher's classroom. A resource network made up of university teacher educators, arts and sciences faculty, instructional designers, and technology specialists supports the effort of the student and professional teachers.

The pilot test of the Instructional Technology Integration Model shows that it can be effective for teaching student and professional teachers to use computers to support their curriculum and that the collaborative curriculum development effort is mutually beneficial to the student and professional teachers.

The ABCD Model

The ABCD Model provides guidance in the selection and development of computer-based instruction for professional teachers in their curriculum. The ABCD Model provides a framework in which the teacher will (a) Analyze the software and their curriculum, (b) Brainstorm connections between the software and the content areas, (c) Connect the curriculum, the information obtained during brainstorming, and non-computer classroom activities, and (d) Define curriculum objectives which may be incorporated into the computer-based instruction and both the computer-based and the non-computer-based activities which will be used to address those objectives. The ABCD Model supports the decision-making process and guides teachers in the selection, implementation, and integration of computer-based instruction in their curriculum.

An Integrated Approach

Student teachers who have received their computer education with the Instructional Technology Integration Model enter their student teaching practicum prepared to select, prepare, and use computer software as a teaching tool. During the pilot test of the model, the student teachers often became the professional teacher's best resource for information on the use and operation of computer technology. However, the student teachers did not have the

experience necessary to effectively select appropriate software for their curriculum.

Using the ABCD Model to structure the student teacher's computer education and experience and the professional teacher's curricular knowledge and experience should simultaneously (a) increase the amount of computer use in the K-12 curriculum and (b) increase the quality of computer-based instruction by all teachers participating in the project.

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Moving Toward a New Era: The Classroom Teachers' Story

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The restructuring of university preparation programs in professional development schools have centered on expanding the university students' experiences in the k-12 classroom. The Holmes Group (1986, p. 56) advocated that a design for improvement in tomorrow's schools is found in the structure of the professional school, as a collaboration between universities and public schools. Practicing teachers and administrators together with university faculty in a partnership (practitioners) think, analyze, make knowledge-based decisions and implement them effectively (Levine, 1997). These practitioners are exemplars and supporters of good practice. The professional development school, a teaching hospital, emphasizes teaching and learning in clinical settings, linked with research and practice.

Levine (1997, p. 66) points out three critical attributes which define the standards of quality of the professional development schools. They are: (1) the nurturing of a true learning community capable of providing support for adult and children learning; (2) the characteristic of a true collaboration both within and across partnering institutions; and (3) accountability for quality teaching and learning. These attributes are reflected in the longer time period instituted for the preservice teacher internship. Many experience both the first and last day of school, events for which there can be no training other than authentic exposure. The preservice teacher actively participates in classroom and district activities such as professional development, staffing, assessment approaches, and research much sooner. Research shows that at the end of the internship, the preservice teacher's exit scores and the percentage pass rate of students in the field-based experience have exceeded that of the past traditional programs, indicating a trend in favor of professional development centers (NETCPDT, 1995).

One component of this successful restructuring has come through the infusion of technology in the k-12 and the university student's learning experience. Classroom teachers reported that, with technology, their students were more motivated and productive. The reason for this success was linked to two factors: the placement of technology into the classrooms rather than in labs, and the related on-going staff development and support (NETCPDT, 1995). Because teachers integrated technology into their instructional goals, they found it instrumental in creating student-centered, project-based activities. Also this spurred many educators to use the technology for their own personal use. These teachers were using more technology than teachers from schools who previously had acquired computers for computer labs. Their efforts have led to compressed video and other distance learning technologies placed in remote areas to access more educational resources.

This paper will highlight how one university and its surrounding public schools have joined together to use a combination of technology and both new and traditional teaching methods to improve the skills and abilities of preservice teachers. What beginning teachers learned in the university technology classes, and how they have actually integrated technology into their classroom instruction is the focus. Suggestions on what technology instructors can use when training preservice teachers will also be discussed.

University Coursework: What was taught

Preservice teachers take two technology courses that prepare them for the public school classroom. They take this knowledge into the classroom and practice under the supervision of the public school mentor teacher. Students start with discovering why they should learn to use the computer and what it has to offer. Later, they move through assignments that include traditional word processing database and spreadsheet educational applications and extended applications such as sending messages by e-mail, doing research on the internet, and making slide presentations for their classes. The preservice teacher learns to use operating systems and user interfaces to run programs; to access, generate and manipulate data and to publish results. As they advance in the course, they use technology to enhance their professional growth and productivity by using technology to communicate, collaborate, conduct research and solve problems. In addition, they plan and participate in activities that encourage lifelong learning and promote equitable, ethical, and legal use of computer/technology resources.

As students continue through the second course, they apply computers and related technologies to support teaching and learning in their grade level and subject area. They plan and deliver instructional units that integrate a variety of software, applications, and learning tools. Lessons developed reflect effective grouping and assessment strategies for diverse populations. By the end of the year many are amazed at what they have accomplished and how valuable the knowledge and skills they have gained will be when used in their classrooms.

The Teachers' Story

An interview of several novice and preservice service teachers revealed what skills these teachers actually felt they were able to apply in their classrooms. They filled out a technology survey sheet that contained the following information: the type of computer used; the word processing, database, spread sheet, and slide program used; the use of the Internet (general use), places of access, applications they used, frequency of usage to locate information, the frequency of their recommendations of resources to others, the frequency of downloading the information, and the authenticity of the information; sending e-mail; and whether or not they have been telementored via e-mail.

Many of the teachers and preservice teachers interviewed felt that much of the information learned during the courses or staff development was beneficial during their first year of teaching. All of the teachers said they used spreadsheets to create a gradebook, a class roll, seating charts, certificates, letters, memoranda and overheads. The first course taught one word processing program and its components, which they found problematic. The teachers said that they liked having access to the web to ascertain lesson plans in various subjects, to use test data banks for support of instructions, to communicate with colleagues and participate in professional development by means of telecommunications. They used power point and other slide show programs to teacher lessons. Some of the beginning teachers reported using technology in their instructions in the following ways:

1. One preservice teacher used a math program to help students measure certain objects in weight problems.
2. With the help of the mentor teacher, the preservice teacher designed a program that helped them teach government via the computer.
3. Another teacher and preservice teacher created a persuasive paper that led to a student created slide show presentation.
4. Another preservice teacher used an art program to teach lessons through having access to different museums, and then using museum art to draw designs and create their own pieces of art. For example, with the help of his mentor teacher, the preservice teacher downloaded artwork that refined a lesson on using certain drawing lines to develop a picture. Students watched as the mentor teacher and the preservice teacher team-taught the lesson from the monitor. Students in both of these instances enjoyed and learned the latest information from the Web.
5. One preservice teacher developed a database to keep student records, and actually chart and graph student progress. The teacher charted the progress of her students in a weightlifting program. The students, for the first time, could see that they were making progress, and continued in the program instead of becoming discouraged and transferring out.
6. Another preservice teacher used the web to find information that enhanced his science lessons. The preservice teacher shared how he had asked his students about fish and their sleeping habits. He did not know the answer to his questions himself, but because he had learned how to get on-line to get up-to-date information about questions in science, he was able to retrieve his information and start his class the next day with the answer and photos he found on-line.

Preservice service teachers are encouraged to produce their own activities that can be added to some of the sites or share what they have done by sending responses to my home page (http://www.tamu-commerce.edu/coe/shed/justice) and other educational home pages. These activities give preservice teachers a chance to think about and evaluate what they see others do and what they actually do in their classrooms.

Preservice teachers also communicated with other professionals who teach in their subject area. This helped them understand the process of what other professionals go through when they were planning lessons. These professional teachers gave them tips to assist them in organizing their classroom and in the how-to-skill of applying instructional strategies and management techniques. This on-line contact has richly added to the improvement of their lessons, especially when they are also able to get tips on student motivation, learning styles, multicultural materials, government documents, biographies of scientist or authors, and news magazine articles. Preservice teachers have included some of this information in the presentations that they have made in their classes. These preservice teachers have discovered that the Web has actually added personality, depth, and breadth to their original information.

These anecdotes show how some of the teachers and preservice teachers began to use technology in their classroom because of the collaboration of the public school and university faculty. These teachers are continuing to create different activities that enhance learning in their classroom.

The Collaboration: Changes

As the collaboration process continues, we have all found that the coursework and activities are always under

construction. Through surveys preservice teachers were able to communicate their needs. For example, we found that teaching one kind of program was not helpful in the transfer of that knowledge to other programs. Because preservice teachers were in a number of school districts, all schools did not use the program. Therefore, we looked into several possible alternatives. We began training students on more programs and showing them critical attributes of these programs that would apply to any other program. Because of this knowledge, did not have to stay at the university or at the school campus to complete work. This training has also increased the chances of student teachers being hired in school districts where they have spent their internship.

The preservice teachers and the mentor teachers expressed an interest in taking more technology courses. As a result the university and public school teachers designed a masters degree program. The program focuses on technology and new and innovative ways of teaching. Three different school districts have started in the program and other districts are wanting to become a part of this design.

Preservice teachers have contributed to the way the classes have been taught. As they progress through the courses, they participate in formative and summative evaluations. These evaluations are used to tell us about the needs of the teachers in the classroom. Also they suggested that instructors use larger screens to present and practice skills on the computer. They are eager to learn the latest information; therefore, they want periodic updates to what they have learned. In these courses, changes are continually made, new goals are set, and the vision is continually refined.

Summary

We have looked at our successes and obstacles. We have overcome the barriers and continue to plan a program that will continue to meet the needs of our students. We are flexible enough to take advantage of new technologies and new funding opportunities. Increased funding will help us update the equipment, software and hardware and provide support services. The professional development center has provided us with a vehicle that helps use to invest more time and money in assisting schools in their technological efforts so both can learn from the experiences. Continuous staff development has fostered exploration of advanced technologies. All of the partners feel involved in shaping the technology agenda. All of these efforts are supporting what the professional schools are all about: providing intellectual and technological leadership in the restructuring of the schools for the future.

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Integrated Technologies and Teacher Portfolios

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The Kentucky Department of Education and the National Council for Accreditation in Teacher Education guidelines direct institutions of higher education to plan a continuous assessment component in their pre-service and in-service teacher education programs. To meet these guidelines, Eastern Kentucky University (EKU) has created a portfolio requirement to be used in its undergraduate and graduate teacher education programs. The portfolio requirement incorporates a system that students use to document the achievement of meeting the New Teacher Standards for Preparation and Certification (NTS) and the Experienced Teacher Standards for Preparation and Certification (ETS) from the Kentucky Department of Education (1994a & 1994b) and the guidelines from learned societies. The New Teacher Standards measure the performance of pre-service and intern teachers. The Experienced Teacher Standards measure the performance of teachers who are participating in an in-service development program. The use of integrated technologies will play a major role in the development of a program candidate's portfolio. The purpose of this paper is to explain how integrated technologies will be incorporated into the portfolio process.

New and Experienced Teacher Standards

The New Teacher Standards for Preparation and Certification describe what beginning teachers should know and be able to do in authentic teaching situations. Each of the eight general standard statements describes the category of teaching tasks that beginning teachers should be able to perform. Each standard is followed by a set of performance criteria to be used in assessing the actual quality of performance of first-year teaching candidates. Within the portfolio, each pre-service teacher is expected to document and record his/her performance on specific authentic teaching tasks. Thus, the portfolio is expected to contain examples of quality performance within the categories of designing and planning instruction, implementing and managing instruction, creating and maintaining learning climates, assessing and communicating learning results, reflecting on teaching and learning, collaborating with colleagues and parents, engaging in professional development, and demonstrating knowledge of content. The standards and the performance criteria are not designed as checklists, but rather are to be considered holistically in assessing the performance of pre-service and beginning teachers.

The Experienced Teacher Standards include and exceed the New Teacher Standards with additional criteria and a standard that characterizes what effective, experienced teachers should be able to know and do. The Experienced Teacher Standards stress instructional processes that demonstrate an understanding of the academic, social, emotional, and physical needs of each learner. Experienced teachers are also expected to demonstrate professional leadership within the school, community, and educational profession. The portfolio for experienced teachers contains examples of demonstrated quality performance using authentic teaching situations and a combination of continuing education, professional development and leadership.

Undergraduate Portfolios and Professional Development Plans

At the undergraduate level, teacher education majors at EKU will initiate a portfolio in their first education course, Introduction to Education, EDF 103, (or Transition to Education, EDF 310, for transfer students). They will be given a packet of information containing portfolio guidelines including definitions of terminology, description of format, and expectations of content for the portfolio. They will be required to purchase a binder and divider tabs for organizing

portfolio pieces that will be keyed to Kentucky's eight New Teacher Standards. The portfolio pieces will be completed as part of course assignments in subsequent required courses.

Each course will have one performance task/product that is related to one of the New Teacher Standards and that will be evaluated by the instructor using a holistic scoring guide. Students will choose their best efforts from among these products and file them in the binder along with the instructor's evaluation to demonstrate their progress toward meeting the New Teacher Standards. Although there are eight standards, a student could include fewer than eight products by explaining how some products document growth in more than one standard.

The teacher education portfolios will be presented and evaluated at three points as students progress through the teacher education program. The first presentation will occur at an interview required for admission to the program. At this point, students will meet with their academic advisor and one additional faculty member. The portfolio will be evaluated for recommended format, and it should contain a letter of presentation and reflection, a statement of educational philosophy, an autobiography, an optional personal entry, and two or more performance tasks from EDF 103 or EDF 310. At least one of these tasks must have been scored at by the instructor at level 2 or above on the 4 level scoring guide.

The second presentation will occur at an interview for admission to student teaching. The portfolio at this point should contain performance tasks that demonstrate a minimum competency across all eight New Teacher Standards at level 2, with at least half scored at level 3 or above. It should also contain documentation of a service learning project. The third and final presentation will occur at a program exit interview following the student teaching semester. Items added at this point will include a videotaped lesson from student teaching and the student's reflection on this lesson, performance tasks from student teaching, and the added criteria that no task is scored below level 3.

Professional development plans will be addressed in the portfolios in connection with Standard 7, engaging in professional development. Students' reflections will provide a basis for plans designed to improve their own performance and expand their teaching repertoire. Professional development activities will include items such as course work, the student teaching experience, the service learning project, and evidence of attendance and participation at professional meetings and workshops.

The use of technology in the development of undergraduate portfolios will be encouraged from the beginning of the process and will include a variety of approaches. For example, in the first class, students can access and print the required packet in the College of Education computer lab. Education classes will require the use of word processing for performance tasks, and other productivity software will be used for specific products (e.g. writing and illustrating a patterned language book).

Graduate Portfolios and Professional Improvement Plans

Beginning in the spring semester 1998, a Professional Improvement Plan (PIP) and Graduate Professional Portfolio (GPP) will become part of the Master of Arts in Education (M.A. Ed.) degree and the Rank II non-degree programs. For example, the M.A. Ed. in primary through fifth grade program consists of 15 hours of Professional Education Core, 12 hours of Subject Matter, and 3 hours of Elective course work. The Rank II non-degree program is a coordinated program of study that guides the student through 32 credit hours that meet Kentucky Department of Education guidelines. This program consists of 12 hours of Professional Education Core, 12 hours of Subject Matter, and 8 hours of Selected Elective course work.

Within the first six credit hours of either program, students are to enroll in the required curriculum course. In this course, the students will be introduced to the Graduate Professional Portfolio and will write a personal Professional Improvement Plan. The students will provide information about how they plan to improve their professional performance in each of the nine Experienced Teacher Standards. The student will use the portfolio to display artifacts providing information about performances that meet the improvement plan. Entries in the portfolio and the PIP must reflect growth in each ETS.

Each course taken throughout the program should provide students with opportunities to move toward fulfillment of the PIP. A performance or product from each course in the student's graduate program could also provide appropriate portfolio entry materials. The students will decide what materials from the activities experienced during in their programs will be placed into their portfolio and how those experiences fulfill their PIP.

At the end of the Master of Arts in Education degree program a comprehensive assessment will provide the student and his/her graduate committee an opportunity to assess the fulfillment of the PIP and completion of the GPP. The portfolio should contain artifacts that provide evidence that the performance criteria for each of the nine Experienced Teacher Standards were met. Students in the non-degree Rank II program will meet with their advisor for an exit interview. Using a planned format, the advisor will conduct an assessment exit interview focusing upon the completion of the PIP and the GPP.

The first experience in providing graduate students with information about the PIP and GPP will occur in Spring 1998. Each professor who teaches a graduate curriculum course will incorporate information during course time that concerns the PIP and GPP. Information will be provided to help

students begin their portfolios and write their PIPs. The elementary curriculum course will be offered as a distance learning opportunity that utilizes interactive television (viz., Kentucky Telelinking Network, KTLN). Students at distant sites will have the opportunity to learn about curriculum and the new PIP and GPP program requirements. It is believed that more students can obtain information about new program requirements through this medium.

Learned Societies Guidelines

Competencies identified by the professional organizations or learned societies of the disciplines of the graduate and undergraduate programs must be a part of students' portfolios. Performance events or assignments that result in a product other than a paper and that reflect mastery of a competency will be a required entry. One way that this will be achieved is through the use of integrated technologies.

Integrated Technologies

Seels and Richey (1994) in their book, *Instructional technology: the definition and domain of the field*, define integrated technologies as "...ways to produce and deliver materials which encompass several forms of media under the control of the computer" (p.40). The "media" within this definition includes several forms of integrated hardware and software. To illustrate, digitized information from photographs, video segments from tapes or disks, hypermedia authoring tools, web-based development, networking software, audiographics, and interactive television are all examples of media being controlled by the computer.

Extending the definition of instructional technologies, Seels & Richey (1994) also define the domains of utilization and development of media. Utilization refers to "...using processes and resources for learning" (p. 46). Examples of integrated media utilization include use of specific software within content areas and audiovisual materials such as videotapes, film, transparencies, and CD-ROMs. The important ingredients of utilization are the introduction and follow up activities. On the other hand, development of media is "...the process of translating the design specifications into physical forms" (p. 35). These physical forms may include manuals, books, photography, line drawing, mathematical graphs, video and sound recordings, transparencies, slides, computer-based instruction (e.g., tutorials, drill and practice, games and simulations, databases), authoring tools for hypermedia, and authoring tools for developing web pages. Two current trends in development of integrated technologies are a greater integration of: (a) print technologies and audiovisual technologies with authoring tools for hypermedia and web pages, and (b) technologies for distance learning environments.

Seels & Richey's definitions provide a useful structure when considering portfolio development for graduate and undergraduate students. While the Kentucky New and Experienced Teacher Standards combined with the learned societies competencies serve as a framework for the organization and management of the portfolios, the utilization and development of integrated media forms provide for infusion of instructional technologies into the portfolio process. As graduate and undergraduate students prepare portfolio entries, the use of integrated technologies includes four aspects: a) systematic matching of learners with instructional resources, materials, or both; b) developing lesson plans that demonstrate learners' interaction with the resources, materials, or both; c) guiding learners while they are engaged with the resources, materials, or both; and d) assessing results achieved by the learners after they are engaged (Seels & Richey, 1994). What is most important to consider for each portfolio entry, constructed by the graduate or undergraduate student is the "interface" between the learner and the resources, materials, or both.

Sample portfolio entries that demonstrate utilization of integrated technologies into a portfolio are varied. One example would be when graduate students, undergraduate students, or both are given the task of preparing a learning environment with an interdisciplinary approach to content. P-12 students in this learning environment might be required to collaborate, research, present, and develop a product for a particular concept (e.g., the effects of war on children). The first step for the graduate or undergraduate student may be designing and implementing lesson plans for helping the P-12 students develop or refine search strategies, develop or refine research skills, and evaluate resources. This process might be introduced by discussing search structures for the various integrated technologies including print, CD-ROM, and web-based reference resources and materials. Results of the search may include locating credible videotapes. At this time, the graduate or undergraduate student may choose to model selecting and implementing videoclips in a presentation for the P-12 students. Effective use of videotapes in classrooms generally requires selecting videoclips so that particular concepts may be reinforced or learners may construct generalizations. In this example, each of the lesson plans designed by the graduate or undergraduate student, along with documentation (videotape of the lesson) can be incorporated into the appropriate Kentucky new or experienced teacher expectations and learned society competencies. In addition, the graduate or undergraduate students may want to enhance their portfolios by including entries demonstrating the manipulation of the resources and materials into development a product, thus moving into the domain of development.

Integrating technologies within the development domain involves graduate students, undergraduate students, or both forming products by constructing physical forms of media for utilization. These entries or products are then organized by filling in the appropriate area of new or experienced teacher expectations and learned society competencies, thus documenting achievement of standards.

Utilization of these products may occur through opportunities for providing professional development for colleagues, collaboration with colleagues, or through use by P-12 students. Portfolio entries should provide evidence of using a variety of integrated technologies such as productivity tools, hypermedia authoring tools, presentation software, web-based tools, and distance learning tools. Thus, the domain of development involves the synthesis of information into a new product so that a concept is illustrated or problem-solving situations are presented to the learner. This product may contain new text, visuals (e.g., photographs and line drawings) which are created on a computer, scanned, or imported to enhance the text or videoclips selected from film, video, or videodisks. In addition, new video may be produced and edited to further illustrate a concept, to provide oral histories, or to demonstrate a dramatic play. Finally, sound may be selected from previous resources or new sound created to reinforce the concepts. Web sites may be referenced so that the learner (viz., the one interacting with the product) may further investigate/research the concept or topic. Using information synthesized from these searches a web site may be constructed to focuses on the concept.

Summary

All students in the undergraduate Teacher Education Program, the Master of Arts in Education, non-degree Rank II and Rank I programs are required to submit portfolios prior to the completion of their programs. The content of the portfolio is determined by the competencies of the Kentucky New Teacher Standards for Preparation and Certification (1994b), the Experienced Teacher Standards for Preparation and Certification (1994a), and the learned societies of the various disciplines. Entries or artifacts in the portfolios are indicators of the performance and mastery of the competencies by the preservice or experienced teacher.

The use of integrated technologies in the production of the portfolio is strongly encouraged. The technologies must be incorporated so that the infusion of instructional technologies across the curriculum becomes transparent, and the use of the technologies in teaching is automatic. Portfolio entries may be in any physical format such as print, video and sound recordings, transparencies, slides, CD-ROMs, and disks. What is essential is that there be integration of all technologies, used as tools or displayed as products.

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Starting from Ground Zero: Integrating Technology in Education Programs

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In teaching, new ideas and teaching methods cycle in and out of favor more frequently. Integrating them solidly into practice, however may still take several years (Brown & Henscheid, 1997). The idea of using technology in some schools of education has been articulated, but has not always been put into practice. One reason may be a long-standing assumption that when students take a basic course in technology they are prepared to use the concepts as a part of their training in education.

Current technology has allowed us to simplify our lives, become critical consumers of information, and bring the world a little closer to home. Technology allows university faculty to access information and expose students to ideas, issues, and resources beyond the geographic boundaries of their actual location. However, simply placing technology in front of pre-service educators and administrators will not ensure that they use this medium of information acquisition to effectively instruct students or improve the quality of their work.

There is an effort to provide educators with the skills they will need to become knowledge navigators who will pilot their schools and classrooms to the very edge of human knowledge. Educator explorers will reach out and touch experts in the community, in the nation, and around the world as pioneers on the knowledge frontier, and as "hands-on" practitioners. In order for educators to be able to do this, it is necessary for programs that work with educators to incorporate the use of technology as a part of programs being offered.

Several courses being taught in the School of Education at South Carolina State University are utilizing a variety of available technologies in conjunction with cooperative learning and collaborative problem-solving, to deliver the content of the courses, while modeling effective strategies for using technology. Faculty members from a variety of disciplines collaborate on effective methods of presenting information to undergraduate and graduate students using appropriate technology.

Students enrolled in these courses are required to engage in activities that allow them to use existing technology (i.e. wordprocessing, databases, Internet searches, presentation packages) as a part of the learning process. Faculty members present information in the courses using the kinds of technology that will enhance the learning process. Faculty members and students work collaborative to determine methodology that is effective and those areas that are ineffective.

Background Research on Standards and the Use of Technology

Several factors were considered when exploring the possibility of integration of technology in education courses in School of Education. As educators begin to explore how technology will be used in the area of education, it was imperative that issues of relevance are addressed. If teachers' primary use of a computer is to be a reward for students to play computer simulated games or to be used as high tech drill and practice sessions, then less expensive methods may need to be considered. All educators, from administrators to classroom teachers, must resist the urge to give in to the public pressure of having students work on computers because of high visibility media attention or for other non-academic reasons. Higher education programs must be careful not to perpetuate the "use of technology for technology's sake" mentality among its graduates.

While the promise of educational technology promotes sense of both enthusiasm and urgency among public officials and academicians, a key element of the educational process is often absent from these discussions – faculty development. Faculty must include current technologies in their curricula, thereby empowering graduates with the knowledge and understanding of appropriate and productive use of technology. Scholars have advocated integrating computer elements throughout the courses in undergraduate programs (Scherer, 1985, AACTE, 1985; Berger & Carlson, 1988; Billings & Moursund, 1988; Bitter & Yohe, 1989; Callister & Burbules, 1990). Course work in these programs, however, needs to be redesigned to integrate technology in both methods and foundations courses so the technology is

used in relevant contexts (Todd, 1993). An initial investigation indicates that most faculty members do not have the technical skills to achieve these goals. There also is very little motivation to acquire the necessary technical skills to integrate or require the use of technology in current education courses.

Therefore, as technology should be integrated as a natural part of the education process, it was felt that all educators should be aware of the functionality of technology through an integrative approach. Kovalchick (1997) suggests those elements from both competency-based models and integrative models are blended into a reflexive approach in which students use technology as both learner and teacher. In this way, preservice teacher education students and students working on advanced degrees in administration are challenged through direct experience to generate personally relevant conceptions of technology. When examining the uses of technology, it was imperative to consider the proposals made by Duffield (1997) in that technology should be integrated into existing courses and not seen as separate from the subject areas.

Primary Uses of Technology

The school of Education at South Carolina State University offers initial certification programs at the undergraduate and graduate (masters) levels in Early Childhood Education, Elementary Education, and in the secondary areas of English, History/Social Studies, Industrial Education, Mathematics, and Science. The graduate program in Educational Administration offers certification to school principals, district level coordinators, and superintendents. The Educational Specialist Degree and Educational Doctorate Degree are offered through the Department of Educational Administration.

The uses of technology as a part of these programs is focused primarily on the use of: wordprocessing, databases, statistical packages and spreadsheets, the Internet as a research tool, e-mail as a tool for communicating (student to student and student to professor) and presentation software as a part of classroom instruction and class projects. As in many other programs, only a small proportion of faculty is utilizing technology. These faculty tend to be "innovators" or "early adopters" rather than "mainstream" faculty (Frayer, 1997).

The use of technology in the School of Education corresponds with the *1996 National Survey of Information Technology in Higher Education.* This report by Kenneth Green notes that the percentages of college courses using various kinds of information technology resources remains relatively low. Table 1 indicates the percentages of technology use in college courses as well as the kinds of technology that is currently in some courses in the School of Education at South Carolina State University.

Table 1.
Uses of Technology in University Programs

Technology	% from National Survey of Information Technology	Utilized in Education Courses at S.C. State University
Multimedia	11%	
E-mail	25%	X
Presentation Handouts	28%	X
Commercial Courseware	19%	X
CD-ROM Materials	9%	X
Computer Simulations	14%	
Computer Lab/Classroom	24%	X
WWW-based Resources	9%	X

The Department of Teacher Education provides an undergraduate initial certification program. All education majors must take two courses entitled Introduction to Education (ED 199) and Socio-Economic Geography (GEO 305). Introduction to Education is a survey of current education issues and exposes students to the field of education, while Socio-Economic Geography allows students to study geographic concepts within the context of educational areas. The National Standards are utilized in order to make the connection between public school instruction and instruction at the university level. The use of technology as a tool is also a major component of these courses. Students are required to use a computer based wordprocessing package to complete all written work. In addition, all students have e-mail accounts and the professors poses multidimensional questions via e-mail. Students are required to respond via e-mail and the evaluation and comments on the assignments are provided to students via e-mail.

In addition to student to professor interaction, students are encouraged to use e-mail for student to student interaction to facility the communication process as a part of cooperative learning activities. Student groups are required to develop, write and deliver group research projects. The research projects must flow as if one person wrote the paper and the group process is held in equal value to the group outcome. Therefore, students send copies of their parts of the project to other group members for comments and review via e-mail. Some groups chose to use a presentation package, such as Powerpoint ®, to present the major points of their project.

Many of the assignments given via e-mail ask students to evaluate the utility of identified web sites in assisting them in understanding classroom concepts, developing class projects, and collecting necessary educational information. Students visit and evaluate web-sites as an integral part of learning critical aspects of the courses in

general and their relationship to the students' specific areas of study. The emphasis in these courses is certainly not the use of technology. However, students are not only exposed to and required to use technology, they are also given any training they deem necessary to complete identified tasks. If future teachers are expected to integrate technology into their teaching methods, faculty must model the use of technology in courses.

Certain courses at the graduate level naturally lend themselves to the inclusion of technology or already contain technology components. In these courses, Educational Research and Data Analysis (EAR 710), Advanced Data Analysis (EAR 803) and Survey Research (EAR 804), students use the Statistical Package for the Social Sciences ®(SPSS-X) and Microsoft Excel ® to organize and analyze research data. Students also use current databases on CD-ROM to collect relevant literature on current issues in education.

To develop the use of technology in the Department of Educational Administration, a CD-ROM based law library, that is housed in the South Carolina Institute for Research in Education (SCIRE), is being utilized to supplement the current course in School Law (EAM 738). Students are able to search for actual court cases that pertain to education policies, procedures and regulations.

Faculty members utilize the advanced research services available in the Miller F. Whittaker Library on the campus of South Carolina State University. MIL-LINE is the library's integrated online library system. It allows users to access the library electronically from offices and laboratories using the campus VAX system. Library holdings on MIL-LINE include books, state and national documents as well as CD-ROMS. CD-ROMS on MIL-LINE utilized by School of Education faculty as a part of undergraduate and graduate courses are, Book Review Digest, Education Index, ERIC, and Statistical Abstracts.

Future Plans for Technology Integration

Programs that are in the infancy stage of using technology can, because of technology, use the experiences of other educational programs. The information highway allows faculty members to read about the activities of other institutions of higher education, and benefit from their work. In order to address the needs of educators and administrators there are several plans being developed to effectively integrate technology in education courses at South Carolina State University. These plans include: the addition of hardware and software to facilitate the use of technology by professors; faculty development in the area of effective use of technology; and the development of innovative methods of delivering information in education.

One of the classrooms used by School of Education faculty is being converted to accommodate the needs of faculty members who are making technology an integral part of their courses. Although the classrooms were specifically designed for methods courses, faculty members who are proposing innovative uses of technology in their courses are being invited to use this classroom. Technology that is included in the design of the classroom are; mounted television sets, a teacher computer station with a projection unit, several student computer stations, and Internet connectivity. This classroom is adjacent to an eighteen station computer lab. The proximity of the computer lab facilitates the process of students being trained to use specific pieces of hardware or software as the need arises during the course.

A university wide project has been initiated to provide resources that will allow faculty, staff, and students to use campus-wide Intranet and Internet tools to improve academic instruction and student services. The Multimedia Development Institute (MDI) has been established to assist faculty in the design and development of an Intranet of web-based applications, including courses, course materials, and student services information. This Intranet will also include some commercial applications as well. To insure adequate access to this Intranet and to the Internet, an open student lab will be established. Faculty participants in the MDI will receive multimedia development systems and appropriate training for the development of appropriate courses or modules within courses that integrate technology into the learning process. In addition, an Internet security firewall will be established to provide data integrity and ensure confidentiality of student information.

Faculty members are working towards creating asynchronous learning environments, i.e. learning that is time and place independent. These methods would serve the needs of a growing diverse population of individuals and professionals whose needs extend beyond the traditional boundaries of the university setting. Ideas and strategies that are implemented need to be evaluated and analyzed to determine their effectiveness.

It is the belief of a core group of faculty members that technology will allow the School of Education, to improve existing instruction, maximize the use of current resources, and target new student markets. The primary barrier to integrating technology into the programs in the School of Education appears to be in the connection between, what faculty members do, and ways that technology can improve this process. However, with more faculty development being provided, the enthusiasm and drive of a core group of faculty members serving as the catalyst for change and the acquisition of resources to support the use of technology this barrier can be overcome.

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Authentic Approaches to Encourage Technology-Using Teachers

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Technology, effectively used, has the potential to restructure schools, and to empower individuals to solve problems creatively and to interact effectively with complex information (Jonassen & Reeves, 1996; Means, 1994). Although schools must enable students to "become information literate and skilled in using computer-based tools" (Rakes, 1996, p.52), Collis (1996) contends that the teacher shapes "the eventual success or lack of success of any computers-in-education initiative"(p. 22). Teachers are key to putting technology in the hands of students by integrating it into the learning environment. By using technology as a natural and necessary part of classroom practice, teachers can give students the knowledge and experiences they need. For students to be better prepared to *learn with* technology, teachers need to be better prepared to *teach with* technology.

Theoretical Framework

There is great interest in the concept of situated cognition as a way to encourage authentic learning. This concept is based, in part, upon a Vygotskyan construct recognizing that knowledge cannot be separated from the situations in which it is used. In an authentic situation, a learner is located at a particular time and place. What is learned in that place is knowledge in context. It is embedded within the activities of that context as well as the meaning derived from that context.

In the forefront of research on the value of situated learning, Brown, Collins & Duguid (1989) argue that learners are hindered in their ability to transfer knowledge when it is not learned in context or in the authentic setting. "Learning and cognition, it is now argued, are fundamentally situated" (p.32).

Helping future educators to perceive technology as meaningful, authentic and necessary for their work as teachers is a goal of many teacher educators. The classroom teacher's work includes both instruction and management. Those of us teaching and using technology in pre-service courses have an interest in our students' ability to transfer these acquired skills into their future classrooms. Not only are we concerned with their technology skills, we also want to generate attitudes and beliefs which facilitate this transfer. In this regard, both cognitive and affective domains are significant and must be considered. To a large extent, a teacher's ability to integrate technology into the classroom depends on the modeling and classroom experience that person had as a pre-service teacher. While there might be some technology modeling in education methods classes, for the most part, the old model which excludes technology still is in place (Ingram, 1992)

Many teacher preparation programs do not place pre-service teachers in the field until their last year of undergraduate study. Therefore, these students have a limited opportunity to explore apprenticeship learning and less opportunity for connecting skills developed in their pre-service classroom to an authentic experience. There are pilot programs that have given pre-service teachers the opportunity to observe technology using teachers in the field and to use technology in their student teaching experiences (Balli & Diggs, 1996; Wetzel & McLean, 1997). These projects have reported a positive effect on teacher candidates in terms of their knowledge and attitudes toward technology. As teacher educators we are concerned with enabling teachers to use technology and to accept and understand technology's role in the classroom.

Purpose of the Paper

For technology to be integrated into K-12 classroom practice, teacher learning of the technology must occur at the pre-service and in-service levels. It is our contention that it is necessary to address ways to bridge these two stages in the professional life of teachers. This paper suggests three approaches to encourage technology learning and subsequent use by pre-service and in-service teachers: (a) finding the self in the technology (pre-service teacher education); (b) "if you build it they will come" - involving teachers in the development of technology tools to encourage use (in-service teacher training); and (c) helping future practitioners toward a vision of themselves as

technology-using teachers (the bridge between pre-service and in-service).

Pre-service Teacher Education and Technology

We believe that in order for pre-service teachers to consider technology as necessary for their future work in their classrooms, they need to perceive technology as essential to their lives at the present time. The technology modeled in their course work must address ways to assist them with their current challenges as students. Teacher educators must be aware of their students' needs in courses and encourage them to use newly acquired technology skills to meet class assignments. This provides an opportunity for the students to use technology in the authentic context of their present moment.

We have observed the importance of encouraging pre-service teachers to use technology as a means of self-expression. When a student is able to use a tool as a means of self-expression, the value of the tool is increased. The objective in these activities is to develop fluency and skill in the use of the technology as a means of creative self-expression. When this occurs, the student begins to regard the technology as a tool that is as essential as the paint-brush is to the artist.

In the context of the introductory technology course, pre-service teachers explore the use of various technology tools and are assigned to use them in ways, which convey information about themselves. Examples of these activities include using a graphics program to create a "postcard" telling what they dream and creating a HyperStudio stack that reflects their growth over the process of the course (i.e. a reflective portfolio). These activities designed to encourage students to use the technology to express the self. Other activities focused on making the technology relevant to their needs as learners in other classes. The goal was to enable the students to use technology to remedy challenges in their current professional situations. One such activity involved a student who learned how to check out and use a portable computer cart from the media center when she needed to make a presentation in her psychology course. Another student created a PowerPoint presentation on her student organization's marathon dance competition. The presentation helped her explain the dance project to university officials. These students experienced technology as having immediate meaning in their current work. They did not have to save for later the technology skill for "one day, when they will be teachers".

In-service Teacher's Professional Development

Positive attitudes can influence the acceptance of any type of technology. Making people aware of how the technology can help them perform their job can change attitudes. Installing any type of computer tool will be of little value in an instructional environment without dedicated, motivated, and energetic teachers. Yoon, Guimaraes, and O'Neal (1995) note that the ease of use and learning are directly related to the users' positive attitudes toward computer technology. The teacher's perception of computer technologies may depend on whether the computer is viewed as an opponent, supporter, or powerful assistant. Hopefully, when the teachers are involved in the development of computer technology, the computer will be viewed as a powerful assistant.

A study conducted by Zammit (1992) revealed that computer software was not used if it could not support the classroom teachers' tasks. Software that was judged as being instructionally weak or inappropriate was found to be a major factor for non-usage. In addition, several commercial applications designed for teachers can be too generic for teachers' tasks. Thus, this study supports the assertion that teachers need to be involved in the design and development of software to meet their specific needs.

Involving teachers in the development phase of a computer tool designed to meet their specific needs can change their perceptions and attitudes towards technology. Their direct involvement in the product's development enables teachers to envision the capabilities of the technology. The computer tool becomes more meaningful as the teachers experience a sense of ownership. The teachers' input into the development process also assures a more accurate congruency with their needs. These points illustrate the significance of having teachers' feedback recognized as a critical component of the formative evaluation process. Their vision of the completed product and its' anticipated usage acts as motivation for them to accept the technology. This process also encourages confidence building.

Alavi and Napier (1984) describe three different interactions that occur in the rapid or adaptive design process. First, the user-system interaction pertains to how the user's characteristics affect the system utilization as well as how the user's understanding of the decision task and its potential solutions can increase by using the system. Second, the user-builder interaction involves communication and collaboration during the system development process. Third, the builder-system interaction occurs when the builder adds new capabilities and functions to the system as a result of evaluations and new knowledge learned in the decision environment.

These three interactions help to deepen understanding of how and why to use the computer technology. By working with the technology's primary designer and offering suggestions, teachers are being "in-serviced" during the development process. Also, by making design decisions concerning the technology tool, teachers are building a sense of ownership. Training and expert assistance is considered important for encouraging computer usage

(Vockell, Jancich, & Sweeney, 1994). The knowledge acquisition process is an important task for the design and development of technology in education just as it is in the business environment. School personnel are considered the experts in this situation and they must be able to communicate and cooperate with the developers of the system (Telem, 1990).

An example of teachers sharing in the development process is a university-schools partnership project that invited classroom teachers to participate in the design of a computer tool. This computer application is being developed with a modular and rapid prototyping approach for middle school teachers who have been involved since the beginning of the project. An initial prototype of the tool was presented to the participating teachers. Their formative evaluation provided important feedback that was used in refining the prototype. The new prototype was presented again to the teachers and their suggestions were documented for future enhancements. The cycle will continue until all stakeholders are satisfied with the computer tool.

As teachers become confident in using the technology that they helped to create, the skills acquired during the development process can be transferred to similar computer applications. When teachers develop more skill with computer technology, they may see patterns and similarities between computer applications. This may help them in selecting and applying appropriate technology to their daily work processes, such as guiding student learning. This ability to see similar patterns allows for possible transference of what they learn. Heightened motivation is also a factor. (Bassok & Holyoak, 1993). Authentic usage seems to be key. When the technology is used in the context of a real life setting, teachers better understand how to integrate it into their work.

Bridging the Gap

Researchers have provided compelling argument as to the importance of placing pre-service teachers in the authentic setting of the K-12 classroom. One pilot project studied pre-service teachers' placement in an elementary classroom as part of a field experience (Balli and Diggs 1996). The students incorporated technology into a practice lesson that they taught in their observed class. They reported that applying technology-based lessons in the field experience helped them to connect theory and knowledge into practice. They also saw concrete examples of ways in which technology could support learning for children in K-12 settings. The question of transfer from pre-service to in-service was an underlying concern of the researchers. It was their contention that "if pre-service teachers used their newly acquired technology skills in an authentic classroom situation, the experience could enhance their understanding of how technology can support teaching and learning" (Balli and Diggs, 1996, p.57). The results of the students' technology-enriched field experience showed that they had a deeper understanding of how and why to use technology within the structure of the K-12 learning environment.

As the previous description indicated, the authentic context contributed to prospective teachers' transfer of theory into practice. By maximizing the opportunities of a field placement, pre-service teachers can practice and observe their mentor teachers using the technology. As Wetzel and McLean (1997) point out, it is important to place pre-service teachers in classrooms where technology use is modeled "appropriately" (p.53). There are some non-exemplars, classrooms where technology is used in non-innovative ways (Wetzel & McLean, 1997), minimally, or not at all (Bosch & Cardinale, 1993). Work in the field is a salient way to help pre-service teachers experience deep learning of how to effectively and innovatively use technology in their future classrooms. In some instances a field placement is not available to the students when enrolled in the introductory technology course. Although not as optimal as an actual field setting, there are activities the undergraduate instructor can employ that challenge the future practitioner to "think like a teacher".

It is important to help pre-service teachers develop a vision of themselves as technology-using teachers. By helping them "practice" developing effective ways to implement technology in their future classrooms, pre-service teachers will begin to build a framework for how to use technology effectively with their students and as a tool in their work processes. When they situate themselves in the role of a technology-using teacher, they can start to develop an internal sense of how necessary the technology will be in creating a successful, exciting and active learning environment.

Pre-service teachers begin to construct the "bridge" when they describe themselves as technology-using teachers through narratives, role playing and self-as-teacher discussions. In an introductory technology course, pre-service teachers were shown how to use particular technology tools such as database and graphics software, video and digital cameras, and HyperStudio. After the instructor demonstrated these and other tools a discussion of how these tools might be used in the classroom would ensue. While the structure of these discussions would vary (think-pair-share, whole or small group), what was consistent is that the emphasis was on integrating the tool into K-12 classroom practice. In fact, this concept formed the theoretical framework for the majority of the activities in which the students participated. As they placed themselves in the role of teacher, they attempted to specify ways to use the technology to help meet their students needs. Other activities included having students plan technology - enriched lessons and units as if they were members of a grade level team. Decisions about curriculum, budget, and even field trips were discussed within these grade level groups. The group members also appointed a grade level

coordinator. This type of role-playing gives the students the opportunity not only to behave as a teacher but also demonstrates the importance of collaborating and negotiating among colleagues.

Another activity, which helped to put the student in the role of teacher, was scenario-based discussions. The students were given a classroom setting including a profile of the students and learning setting. They then had to apply solutions using technology as a means (not an end) to solving the problem. They could ask further questions of the instructor who served as a mediator with the "insider knowledge" of the learning situation. Questions ranged from details about the school setting to the technology available for classroom use. These scenarios were discussed in small groups and then shared with the class as a whole. These structured activities can give students who do not have the authentic setting available, a way to practice thinking and behaving like a teacher. The link between pre-service and in-service teaching is further built as students integrate into their personal vision of self-as-teacher, meaningful ways to integrate technology into the learning community of their classroom.

Conclusions and Recommendations

Just as every classroom in every school is unique, so are pre-service technology education programs. The ideas described above are meant to be suggestive only, each teacher educator must decide what activities and approaches are appropriate in their particular setting. What seems important is to continue the dialogue concerning innovative and effective approaches to technology education for pre-service teachers. As future teachers feel prepared to teach in a technology infused classroom they will help their students interact successfully in a technology infused society both inside and outside the walls of the K-12 classroom.

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An Interdisciplinary, Problem-Centered Methods Model for Preservice Elementary Teacher Education

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After wrestling for some time with how best to tell the story of EDUC 453/454-553/554, Methods of Integrating Technology in the Elementary Social Studies/Language Arts Classroom, I have chosen to begin with the students' personal narratives and reflections about their experiences. Following a bit of historical and theoretical background I will share my own challenges and experiences in thinking about, planning, and implementing the course, including the strategies that made the "doing" so meaningful for all of us.

Student Narratives, Reflections, and Evaluations

Andrea: Dear Becky,
For the first time ever, I actually feel that I truly learned an immense amount of information that I can take with me and honestly apply in my own classroom. I am no longer terrified of computers and I have no doubt that they will be a large part of my curriculum. I just loved your class and teaching style...how you respected each of us as people, not just students...you inspired me to go that extra mile and to stretch my thinking, while building my confidence. I am not afraid of going into the classroom and teaching, as well as learning. I have so much faith in myself and my abilities now, much more than I did at the beginning of the semester (Personal communication, 1997).

Christie: I wanted you to know I learned a lot from you this semester. I learned not only about strategies, but how to be a wonderful teacher (Personal communication, 1997).

Melissa: Dr. Willis,
This is to thank you for everything!!! I feel like I have grown sooo much through this course. Being the teacher that you are makes it possible for us, in turn, to become teachers like you have modeled to us. Thank You. P. S. Thank You for the "hand on the shoulder" touch that made me feel cared for as a student and as a person (Personal communication, 1997).

From anonymous class evaluations:

This class was one of the most interesting...I have had to take. Not only did I learn different techniques and strategies of integrating technology into my classroom, but I learned a tremendous amount of information myself. It's just amazing to me how much knowledge I gained on the rain forest! I think the most beneficial (sic) thing I got from this course, was getting rid of the "fear" and frustration I have always experienced when working with computers. I still get frustrated sometimes because things take so long, but at least I feel confident enough with my computer skills that I know how to do something when I need to without asking someone to help. I realize that this was one of the goals for this course, and I just want you to know that you succeeded! Not only did I enjoy the content of the class, but I enjoyed the style you used to teach it. You are one of the only professors I have had that made me feel like I am not just a student in your class. It seemed as if you actually understood that we were almost teachers ourselves, and treated us all with respect in that way. Thank you for a great semester Becky, I truly learned a lot from you. You are a great role model for developing teachers. I hope one day I will have the ability to make my students feel special and respected as you have done (Personal communication, 1996).

I feel that my biggest area of growth was in computer applications. I have learned of and how to use so many programs that I will be able to use in the class. From participating in so many different programs, I have learned how to manipulate the computer. I also learned a lot on current issues, the need to discuss these issues in the classroom, thematic units (ie Rain forest, and the many perspectives in history). I would have liked to have focused on the areas of social studies more. I enjoyed the way Becky introduced our activities. She gave us brief instructions and left us to figure things out, but was always available when we needed help. Becky is a very supportive person. She treated everyone with respect and always made time for the

students. She is very approachable, and was very flexible with assignments. She provided a very non-threatening learning environment. I feel that Becky posses(sic) a important quality which is self-evaluation. She not only evaluates herself and units but asks for areas of strengths and improvements. The only area of improvement I see is that she is sometimes too lenient. I feel that Becky held true to a teaching strategy she believes in which is mushroom management...She challenged us and let the students do inductive learning but was available if we became frustrated. Becky has been a wonderful model for me...I hope that I am as accepting, patient, and as dedicated as she is. She also showed me the importance of: having student's understand themselves as well as other cultures; having students evaluate the lessons/units; having closure and discussing what we learned; modeling and flexibility; giving students "hands on" time. I do not think there is one thing that I have not or will not use in my classroom (written class evaluation, 1996).

My Thoughts on the Student Comments

The sampling above, of students' thoughts and candid evaluations of EDUC 453/454, demonstrate that something very powerful happened in this class, something that had happened neither for, nor to, these preservice teachers in their previous educational experience. Several strands I noted running through the messages were (1) respect for the individual; (2) personal responsibility for learning; (3) trust in students' intrinsic motivation to work independently and with others.

Historical Background

Technology in the Curriculum

The United States, as a part of a global society, is fast becoming defined by electronic technology, in the home, in the workplace, at leisure. Education of young people in such a fluid, ever-changing society has become a complex and challenging task for a system based on the outmoded concept that information remains static and can be transmitted and learned in fragmented disciplinary bits. Enmeshed in this system is the classroom teacher who realizes that the job of teaching students to learn in the electronic world is not being accomplished, but who has little background education on which to rely for a new vision of an interdisciplinary curriculum, nor of how new computer and information technology might be placed within such a curriculum.

For instance, in his recent Executive Summary, "The Information Highway is Bypassing America's Schools," John Cradler (1995) of the Far West Laboratory for Educational Research and Development, includes in his report that:

> Despite available technologies in schools, a substantial number of teachers report they do not use computers and other technologies regularly for instruction...A majority of teachers report feeling inadequately trained to use technology resources, particularly computer-based technologies...Training focuses on the mechanics, not on integrating technology in the curriculum...

Teachers lack an understanding of curricular uses of technology and lack models of technology for their professional use (p. 3).

The Transmission Model

According to Cameron White(1996), "Social studies teacher education desperately needs a shot of innovation" (p. 69). The knowledge transmission model of teaching and learning is what most students experience in their own education from kindergarten right on through teacher certification, so it is little wonder that the goal of students in teacher education programs becomes transmission "rather than a process of interaction and construction of knowledge (Brazee & Kristo, 1986; Shor & Freire, 1987). This model with which preservice students have lived for 16 years of education is internalized and becomes the mode of operation, guiding not just the use and integration of technology, but the whole of a teacher's approach to curriculum in their own classroom. The view of the mind as a *tabula rasa* , a blank slate to be filled, was never appropriate, but is even less so today. With the amount of knowledge estimated to be doubling every decade and computer capability every three years, it seems more important that students become able to process, interpret, and evaluate information than to amass specific knowledge (Post, Ellis, Humphreys, & Buggey, 1997).

The Fragmented Curriculum

Heidi Hayes Jacobs (1989) notes that from early on experience in educational environments students begin to define subjects as separate bodies of knowledge with little relationship or links between them. This delineation between disciplines becomes more entrenched as students move into middle and secondary school where subjects are taught in 35-50 minute blocks by specialists, with little modeling of the relevance of one class or subject to another. In "real life," though, these young adults begin to realize that "we encounter problems and situations, gather data from all of our resources, and generate solutions"(Jacobs, 1989 p. 1). Unfortunately, school days fragmented into discrete disciplinary time slots do not reflect reality.

The Class: Methods of Integrating Technology in the Elementary Social Studies/Language Arts Classroom

The purpose of this course was to assist preservice teacher candidates in developing an understanding and appreciation of the many perspectives of the social studies, language acquisition in all its forms (reading, writing, listening), and a vision of the roles and impacts of technology on the social studies/language arts curriculum. Students would ideally begin to: develop expertise in planning

and implementing informed, interdisciplinary practices of teaching social studies/language arts through literature (whole language, the writing process, and student response); create a computer using curriculum based on models, theories, and research; learn habits of inquiry and reflection as lifelong learners and teachers; and build bridges of understanding among individuals of diverse cultural backgrounds, learning abilities and special needs. These were the stated goals and objectives. However, as I talked with students throughout the semester and received their feedback through reflections, evaluations, videotaping, interviews, and observation, the real power of the actual implementation of the course was stunning.

Strategies utilized and modeled were constructivist in approach: hands-on, problem-centered and interdisciplinary, with technology seamlessly integrated into the curriculum. Students participated in a selection of projects relevant to their own future elementary classrooms (i.e., Rain Forest thematic unit, the Lecture Series), learning to use appropriate computer software, from word processing, graphics, databases, spreadsheets, and simulations, to telecommunications and hypermedia. According to Post, T. R., et al, (1997) "Interdisciplinary studies can be squarely placed with the philosophical position that contends that knowledge cannot be transferred directly from one individual to another (p. 19)," but is both personal and social in nature. That is, meaning is individually created by engagement in activity, and, activity with peers "results in an internalization of ideas and the construction of a personalized from of knowledge" (p. 19).

Thinking About and Planning EDUC 453-454/553-554

In the Spring of 1996 the Department of Curriculum and Instruction realized that another section of our methods block (elementary social studies, language arts, reading) would have to be in place for the Fall semester to accommodate increased enrollment. To insure a robust, somewhat standardized methods curriculum for this new section of 30 undergraduate and graduate students, the block instructors decided to try something new. We did not hire part time faculty to teach the additional social studies and language arts classes; instead, we integrated the two courses into one three-and-one-half hour class that met twice a week. Students registered for both classes, and I agreed to teach the integrated class, since I had been teaching the elementary social studies methods, "Integrating Technology in the Elementary Social Studies Classroom," and held secondary English certification in New Mexico. Besides, I was excited to put together what seemed to me to be the perfect elementary, interdisciplinary methods model: language arts, social studies, and technology.

What transpired for me next was three months of hard work and thinking: gathering, reading, and reflecting on information about reading and language arts, brainstorming with language arts and reading methods professors, immersing myself in the latest research on curriculum integration and learning in teacher education.

When the course syllabus for Methods of Integrating Technology in the Elementary Social Studies/Language Arts Classroom appeared on my computer a month before the class was to begin, it was, from what students later told me, mind boggling and just scary. For me, it was the rewarding synthesis of months of challenging thinking about the social studies, language arts, and technology. It was the blending into one entity of three content disciplines. This is what the first week looked like in the syllabus:

Curriculum Integration Concepts

- Modeling a thematic approach to curriculum integration
- Modeling the use of whole, small, and individual grouping strategies
- Modeling Action Research: A Pretest Survey
- Modeling Democracy as a classroom experience: reflecting on a philosophy of education
- Using the WWW in the classroom

Computer Concepts and Skills

- loading a program, loading a file, saving a file, formatting a disk, printing
- Using software: telecommunications, word processors, and graphics
- Mac Basics
- WWW

Class Activities

- Introductory comments
- Video: Technology Unplugged
- Email accounts: Dante, Verdi, Paris, Hector, Netscape, ED-554
- Biopoetry: word processing
- Completing an Autobiography using a word processing application
- Creating a Print Shop Personal Sign for Notebook/ Portfolio: graphics
- Announcing a University Lecture Series: cooperative group meetings as process
- Web Quest using Netscape

Telecommunications Activities

- Sign onto email
- Send a message to beckyw: All About Me
- Netscape: Web search for language arts and social studies standards

Readings

- Reading, Writing, and Email
- Guide to the Internet, 1-44
- Elementary Social Studies, xvii-27

Assignments

- Locate biography or autobiography about lecture series personalities for class work
- Begin vocabulary database: symbol systems (brainstorm, Venn diagram, chart, web)

To give the reader an idea of my approach in the classroom, this is what I did the first class meeting of the week: I sat "in the round" with the group to discuss the syllabus. Actually, they were so intimidated by it that we spent very little time then talking about it. Students then completed the Biopoetry form, an introductory activity in which one student interviews another to complete a poem that begins with the student's first name and ends with their last name; they then introduce each other. This is a wonderful, personal activity that I believe sets the respectful, friendly, supportive tone for the whole semester.

The next activity that day was the completion of a technology survey, modeling that teachers at all levels are, and should be, action researchers. This activity gave me the opportunity to discuss kinds of research in general and appropriate survey participation in particular, and, of course, collect my own data.

Following the survey, email accounts were set up for all students and a brief demonstration of our telecommunication software was given. They had an email assignment immediately...to email me several paragraphs about themselves, which was an extension of the Biopoetry activity. And, to introduce them to the Internet and the World Wide Web, another immediate assignment was the completion of a short-term Web Quest.

Additionally, brief demonstration was given for the computer graphics application *Print Shop Deluxe*. Students then worked to complete a personal sign to be included in their personal portfolio, a further extension of the personal emphasis of the class.

Most of these students had very little computer experience and many wanted, at the outset, to have "cheat sheets" for guidance for the technology activities. What they learned through mistakes and intuition, trial and error, however, gave them one of the most important learning outcomes—self-confidence. Later, no one even wanted me to show, even briefly, how an application worked—they wanted to do it themselves.

What a first day! And so the semester continued...

Based on the national standards for the three content areas, what I planned to have happen was that these preservice educators would experience interdisciplinary activities, they would "be" lecture series planners and understand the power of language through reading, writing, and speaking; they would "do" social studies through research and reporting on the Rain Forest. Further, students would learn a variety of computer software applications to assist them in "being" and "doing." Plus, they would work in cooperative groups, as well as be responsible for individual components of their projects.

When I look at what I have just written, it seems like a huge undertaking, one fraught with danger and doubt as to outcomes. At the time, though, I was confident that my plan was based soundly in learning theory and my own experience with other classes. More importantly, I knew "down to my toes" that students could and would respond positively to the challenge I was offering.

Were these students confused by what was being asked of them at the outset? Yes.

Did they mutter that the work required for the class appeared insurmountable? Yes. Did they see the interdisciplinary "fit" early on? No.

Were they anxious about using computer technology? Yes.

Did they resent my group making? Yes.

Were they concerned that everything was not given a grade? Yes.

But the evaluations, comments, interviews, and videotapes are a testament to what these students in EDUC 453/454-553/554 accomplished, to their engagement in the learning process. After the first week, when they truly understood that their choices, their judgment, their learning was the class priority, the fun really began. Each one of us pushed our individual envelope, teaching each other and ourselves more than I could possibly have planned for us. These preservice teachers demonstrated to me again the fascinating diversity of learners and the power of the learning environment; they learned from me to trust themselves as learners and teachers.

Importance of the Integrated, Interdisciplinary Model

In order for preservice teachers to become technology-using, constructivist in approach, and designers of effective interdisciplinary curriculums for their own classrooms, they must experience that environment first-hand. They must participate in hands-on, problem solving, and critical thinking processes as students themselves. Models of integration and knowledge construction must replace the transmission model of education still so prevalent in teacher education if we expect teachers to develop those skills for their own K-12 curriculum. And, for that to occur, teacher educators must be the models for those strategies. Methods of Integrating Technology in the Elementary Social Studies/Language Arts Classroom was just such a model. It became clear through the engagement and voices of the preservice teachers that they became active, constructive learners, who were confident in their ability to integrate technology into an interdisciplinary curriculum when they were presented with an appropriate model in a learning environment that made them responsible for their own learning.

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A Collaboration of Five Teacher Training Institutions: Preparing Illinois educators for the 21st century

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The global information technology revolution and new instructional strategies have the potential to significantly improve the learning environments of K-12 students throughout the country. Despite theses capabilities many of today's preservice and inservice K-12 teachers are not adequately prepared to utilize computing, communications, and other technologies to support teacher-facilitated technology-based learning experiences for K-12 students. *Teachers and Technology: Making the Connection*, (U.S. Congress, 1995) confirmed this by making us aware that "technology is not central to the teacher preparation experience in most colleges of education. Consequently, most new teachers graduate from teacher preparation institutions with limited knowledge of the ways technology can be used in their professional practice (p. 165)." According to the report, "Helping teachers use technology effectively may be the most important step to assuring that current and future investments in technology are realized" (p. 2). Few preservice programs are sending forth teachers prepared to use technology well as an instructional tool in their new classrooms. We know that helping teachers must continue beyond their preservice programs as well. One of the important factors in the school setting is administrative support. Lack of administrative support is most critical because it is linked to other factors that help teachers such as staff development, resources, and ongoing planning (Ritchie, 1996).

The Illinois State Board of Education (ISBE) adopted a K-12 Information Technology Plan (1996) developed by the ISBE Infrastructure Planning Team and the ISBE Technology Coalition. The Plan presents strategies for closing the gaps in technology in Illinois schools by the year 2000. Recommendation #7 in this document suggests requiring preservice teachers to demonstrate proficiency in the use of hardware, software, and related technologies to receive certification.

Calling for more technology focus in higher education, Lawrence Werner of the Illinois State Board of Education highlighted the following:

> The Office of Technology Assessment (OTA, 1995) concludes that reform of teacher education should accompany any significant reform in K-12 education. In addition, teacher education faculty and cooperating K-12 teachers must model effective instructional technology use. The OTA reports that Colleges of Education have much to learn from each other and technology can be the catalyst to make the necessary connections. Colleges, the state and K-12 schools need to work together to develop a set of shared expectations for joint reform efforts.

The PIE-21 Project

Five Illinois universities, the National Center for Supercomputing Applications (NCSA), and Illinois Area IV Learning Technology Hub are collaborating in the Preparing Educators for the 21st Century (PIE-21) program. This HECA/ISBE funded project focuses on providing preservice teachers, administrators, and teacher education faculty with the skills and knowledge necessary to effectively use

information technology. The original grant was funded through the Higher Education Consortium and joined by the Illinois State Board of Education in support of the k-12 participants involved in the projects. Each project includes collaboration between a university and K-12 schools to provide preservice teachers or administrators with training and experiences to effectively use information technology in the classroom. NCSA participated by coordinating the project during its first year, offering technology workshop opportunities, and providing mechanisms for group communication and electronic collaboration.

Key objectives for PIE-21 include the following:

- develop models for teacher preparation that can be adopted at all Colleges of Education;
- prepare faculty, teachers, and students to effectively use information technology resources; and
- establish partnerships within local communities and educational organizations statewide.

Given that each institution is unique, each PIE-21 partner is developing and piloting a different model of integrating information technology into a teacher or administrator preparation program.

Project at Eastern Illinois University

The primary objective of the PIE21 project at Eastern Illinois University is to ensure that student teachers emerge from their college career with the skill and knowledge to be able to deal with information technology as they enter teaching careers. To accomplish this goal, learning communities have been established which involve three faculty members of EIU, four cooperating teachers, seven pre-service teachers and students in K-12 classrooms at three Professional Development Schools. Each faculty member has formed a team along with one or two cooperating teachers and 2-3 pre-service teachers. The teams interact on a level of parity with each team member being empowered equally as part of the collaborative team effort. Each team member has three roles:

1. actively engage as a learner of new technological skills,
2. serve as a mentor to assist other team members in enhancing their technological skills, and
3. serve as a mentor to their peers in disseminating new technological skills.

The teams are designing curriculum projects in three areas.

Special Education. The team is using technology to develop curricular modifications and adaptations to enhance the comprehension and writing skills of 5th and 6th grade students with learning disabilities. The students will be using the WWW to research a pre-selected topic and, using the computer, will write a paragraph about the topic. After reviewing and editing, each student's paragraph will be placed on the class home page to be shared with parents, students, and other individuals.

Middle Level Education. The team is developing a website where middle level students can post science-oriented questions. The audience who will answer the questions, may vary according to the classroom setting. Some questions may be posed for peers at the same grade level and some may be developed for younger students. The questions are designed to develop problem-solving skills using the three highest levels of Bloom's Taxonomy - analysis, synthesis, and evaluation.

Secondary English. The team is developing a website specifically focusing on American Literature and analysis of The Crucible. As research is conducted on the WWW, sites pertinent to the project will be linked to the homepage. The various analyses conducted by the students will be posted on the website and made available to other English classes at the High School. Students from an "honors" class and students from a "regular" class will be involved in the collaborative project along with their teachers and student teachers.

The PIE21 project at Eastern Illinois University is meeting with success as the teams continue to work as a collaborative learning community. Many new technology skills have been learned and the teams are anxious for the student teachers to implement the projects and share their skills with the students during their student teaching semester.

Project at Illinois State University

The Illinois State University model is based on the integration of information technology into methods classes at both the Wheeling Professional Development School (PDS) and on campus. The ISTE/NCATE recommendations are used as technology guidelines for the program.

Illinois State and the Wheeling Elementary District have developed a PDS that annually includes between thirty and forty senior elementary education majors. During the fall semester, students take methods classes delivered on-site and complete a field experience in their assigned classrooms. Spring semester they student teach in the same classrooms. A joint Illinois State/Wheeling committee planned technology workshops and attendance at a technology conference for these students. The workshops provided students experience with finding information on the Internet, communicating with Eudora, ClarisWorks, and multimedia.

The second focus of the grant is the use of the Internet collaborative environment to expand the field experience of junior elementary education majors. This collaborative environment facilitates the discussion of theory and practice focusing on the areas of language arts and classroom management. The collaborative environment currently used is netWorkPlace developed by National Center for Supercomputing Applications at the University of Illinois. It provides a visual environment for threaded discussion groups, a chat area for synchronous communications, and a library for downloads. A goal of the collaboration is for the

undergraduate students to develop an understanding of the different philosophies of teaching language arts and classroom management. Another goal is to have students use Internet technology in a meaningful way to apply what they were learning in the university classroom. This collaborative environment was used in the following two ways:

1. Off campus, Illinois State student teachers at Wheeling were connected with Illinois State University juniors on the Normal Campus who will be in the Wheeling PDS school the following year. They use this collaborative environment to discuss the application of theory that they have learned and to covey information and answer questions for the future PDS participants.

2. On campus, Illinois State students posed questions and discussed theory with teachers in the field to better prepare them for field experience and student teaching. Students in a Language Arts methods class selected topics of interest to research and developed questions in their area of interest. These questions were the beginning of a dialog between teachers in a graduate Language Arts and Technology class and the undergraduate class.

Project at National-Louis University

National-Louis University has been using the ISTE Foundation Standards as a framework to help us move toward greater integration of technology into our preservice programs. That is an ongoing effort at our institution. It is not, however, the ISTE Foundation standards or the Elementary Education program that were the focus of NLU's PIE-21 project. Our focus was the integration of technology experiences into the Educational Leadership program and identifying the knowledge and skills needed by future principals and superintendents.

The major goal was to impact the Educational Leadership curriculum in terms of technology experience for students and modeling by faculty and to build a community of principals who can learn and work together to impact the use of technology in their schools. Toward this end, our team was made up of 3 faculty members of Educational Leadership Department, 2 principals from member schools of our Professional Development School Network (PDSN), 1 student from the Educational Leadership Doctoral Program, and 1 student from Educational Leadership Masters Program. Finally the team included a facilitator and a liaison to the educational leadership faculty who was a curriculum expert.

During the course of the year, members of the group participated in a variety of experiences geared toward making them more aware of ways in which classroom teachers are currently using technology in classrooms; thus making the administrator more aware of the support and resource needs of the classroom teacher. There were also hands-on opportunities to try out software and to explore the WWW.

Other sessions involved visiting schools and having demonstrated the ways in which technology linked the principal (a member of our team) to his faculty and other administrators and inviting a panel of building and district level technology coordinators to interact with this group of faculty and administrators, present and future. This open conversation on what the panel "wished their administrators knew" had a strong impact on future group meetings. Following that panel they met to formally begin to identify the skills and knowledge about technology use that they believed administrators should have. The draft list of knowledge and skills included the following 11 items:

1. use presentation software to share ideas with an audience;
2. use concept-mapping software for brainstorming process;
3. use computer-based technology to collect, analyze and report data;
4. access and use telecommunication tools and resources for information sharing and information access. this includes the use electronic mail and web browser applications for communication and research;
5. use spreadsheets for analyzing, organizing and graphically displaying numeric data;
6. design and manipulate databases for managing school-related bodies of information;
7. use school management tools to design solutions for a specific purpose;
8. describe strategies for facilitating consideration of ethical, legal and human issues involving school purchasing and policy decisions;
9. impact of technological and societal changes on schools;
10. demonstrate knowledge of ways to assist teachers to learn to apply computers and related technologies to enhance the learning environment; and
11. describe current instructional principles, research, and appropriate assessment practices as related to the use of computers and technology resources.

Members of the PIE-21 team began to examine course content to see where these could best be implemented. During the 1997-1998 year the full Educational Leadership team will examine the implementation process.

For Educational Leadership faculty and the current principals, participation in this group was the impetus for their attendance at their first educational technology conference. The participants attended two local conferences and joined in some the pre and post sessions as well. Three of the principals attended the National Educational Computing Conference in Seattle as well. For all participants it was an awakening as they looked for more sessions applying to administrator education and expressed interest in presenting at such conferences.

During the coming year plans include the implementation of the special interest group for area principals.

Project at Southern Illinois University-Edwardsville

SIUE's now two-year involvement with the PIE-21 grant has been a growth opportunity for all six direct participants. SIUE already had a significant program for technology integration and P12-university collaboration before this grant in three areas: an experimental middle school professional development school with an on-site preservice teacher and administrator cohort, a field-based, collaborative on-campus preservice teacher education program, and a rich science education curriculum. However, the grant brought the on-campus participants into close collaboration with technology innovators statewide and, consequent to this, with each other.

Our elementary education on-campus program has two field-based semesters of methods courses followed by a semester of student teaching. Sections in Field 1 and Field 2 are block scheduled so that the cohort stays together in all of their methods sections. Eight technology integration times are scheduled over a two-semester period, and while the technology coordinator is responsible for these, a collaborative team-taught approach is used. The curriculum is web-published. ISTE Computer Literacy Standards and the new K12 State Learning Standards were used to critically redesign our curriculum, especially emphasizing hypermedia, applications and internet tools in a context stressing collaborative learning, problem solving and portfolio building. This year we have focused on developing the concept of portfolio-based evaluation. Students evaluate their own progress in technology competency and integration at crucial points during the two-semester methods sequence. We are also developing a more focused liaison between the technology integration sessions in the first two field-based semesters and the university supervisors of the student teaching experience. We are hoping to institute UIUC's Technology Competencies Database in the coming semester.

The Professional Development School at North Middle School is a site-based two-year preservice program for preparing preservice teachers and administrators funded by the Danforth Foundation. The development of this curriculum has been a model of faculty-staff collaboration. For our PIE project, the most significant technology occurred because the ISTE Literacy standards were used to develop the North curriculum and students must choose to achieve proficiency for a minimum of two technology applications each quarter. The cohort has received both campus-based and on-site training in technology applications. Even more significantly, the staff has had a series of inservice workshops on technology use in the classroom followed up by focused project development periods and individualized coaching. We are seeing a synergy for technology use develop between the cohort and the North staff. Two listservs that are in active use have facilitated sharing and collaboration.

SIUE also included some non-education courses in the PIE-21 endeavor. In particular CI 341 (science methods) emphasized modeling the use of technology, required filling out the survey on the student's understanding and use of technology, required the research paper, charts, and graphs to be computer generated, introduced new technologies into the curriculum, such as using C.B.L.'s for at least one topic, with a pre and post questionnaire about using them, and developed a survey form listing the types of educational technology used during each lesson to be filled out by the instructor. For student teachers the goals were to encourage e-mail as the means of regular communication, to survey both the cooperating teacher and the student teacher on their background and access to technology, and to include as part of the Student Portfolio the Technology Standards Grid assessing the student's knowledge and exposure.

Project at College of Education, University of Illinois, Urbana-Champaign

At the College of Education at the University of Illinois, Urbana-Champaign, we have investigated two uses of technologies for improving the preparation of pre-college teachers. We have implemented and evaluated a new framework for using the Internet to bridge the pre-college and the university environments, which we call "electronic editorial assistance." Secondly we have implemented and tested an innovative way of using the Web to provide support for the accomplishment and evaluation of accomplishment of a set of technology competencies for our undergraduate teacher education students.

Electronic Editorial Assistance

We studied ways in which the World-wide Web can be used to improve preservice teacher education. One of the major strengths of the World Wide Web is that it allows a broader set of people to publish their expertise in a way that is widely accessible. In the past, we have found that publishing exemplary lesson plans developed, implemented, and evaluated by student teachers was helpful to the students, was useful for the next cohort of students (by providing exemplary models), and was widely accessed by people from around the US and across the world. However, student teachers are relative novices - it would be much more useful to publish the expertise of exemplary practicing teachers with many years of experience. However, it is difficult for those teachers to find the time, expertise and motivation to write up their own experiences so that others can benefit.

We have implemented a new framework for student learning, integrated into their student teaching classes, called "electronic editorial assistance." Undergraduate student teachers are given as a class assignment to work

with their cooperating K-12 teachers to identify a "best practice", something that the K-12 teacher has done successfully in his/her classroom that the teacher is willing to share with other teachers. The student teacher writes up the "best practice", shows it to the cooperating teacher for corrections and extensions, and their work together to develop a finished write-up. The write-ups are submitted as a class assignment and graded by supervising university faculty. These "best practices" are then published on the Web, with the K-12 teacher as author and the student teacher as editor. The best of these "best practices" are featured on the web, but all of the best practices are available so that others can make their own judgments.

We have implemented and evaluated this framework during the 1996-1997 academic year with students in a secondary mathematics student teaching program and with students in a general secondary education student teaching program at the University of Illinois. The response to this framework from student teachers, K-12 teachers, and university faculty has been very positive. The published "best practices" have been accessed by a very widely distributed set of people from across the US and around the world. We are planning to work cooperatively with faculty at other teacher preparation institutions to implement this Electronic Editorial Assistance framework more broadly during the 1997-1998 academic year.

Technology Competencies Matrix

New learning environments provided by technology, such as the electronic editorial assistance framework, require alternative assessment of student learning. We have explored ways in which the World-wide Web can support a more richly collaborative evaluation, through a web-mediated database for communication between students and university faculty. In this computer-supported collaborative evaluation, students can see the current state of their accomplishment, can submit evidence of accomplishing a specific competency, can receive feedback from faculty, and can modify and augment their evidence until they have demonstrated competency. For faculty, this mechanism provides an easy way to see where students are, to receive and evaluate students' evidence of accomplishment, and to engage in a productive interaction to help support the students learning through evaluation. It also is a continually updated source of information for students and faculty, providing access to instances of successful accomplishment.

We have implemented this Technology Competency Matrix (TCM) during the 1996-1997 academic year, and have tested it during the Spring semester of 1997 with twelve students in an elementary education student teaching program at the University of Illinois. Students were motivated to use the TCM because it provided them with an electronic portfolio demonstrating their technology competency that they could use as part of their job search. The portfolio was available world-wide to prospective employers through the Internet. In addition, students printed out the relevant web pages and used them as a print-based portfolio demonstrating their portfolio for job interviews with schools that did not have easy access to the Web. The main drawbacks discovered during this initial use was the slowness of the system under load, issues of interpretation of the technology competencies (the first ISTE/NCATE Technology Competencies for Teacher Education Students), and the fact that the system was introduced so late in their academic year. During the summer of 1997, we have worked to speed up the system and to incorporate the revised ISTE/NCATE Technology Competencies, and during the fall of 1997 we plan to use the TCM with an entire cohort of elementary education student teachers for the whole academic year.

Conclusions

Each of the participating institutions made strides toward their original goals. All were interested in continuing their projects into a second year of the grant. Table 1 summarizes each of the models implemented as part of the PIE-21 program, identifies key characteristics, and describes the transfer of technology.

There were direct benefits to each of the institutions through the PIE-21 monthly team meetings. These included 1) an exposure to current ideas about technology integration and how these ideas were being implemented in different ways around the state, 2) a consequent increased confidence locally in what were and were not fruitful avenues of technology integration and K12/university collaboration, and 3) a demonstration of some of the more technologically complex innovations in educational technology being developed at NCSA/UIUC. Another unanticipated benefit was that one of the grant participants had worked extensively on a model for using the ISTE Foundation Standards as a basis for integrating technology into the college curriculum.

Important developments at individual Colleges of Education have been shared with the other PIE-21 colleges and are in the process of being disseminated statewide. Four products have been developed that will be of use to any organization concerned with the education of teachers and administrators. There has been development of strong partnerships among the collaborating institutions with a real and positive synergy generated by this project. It has added impetus to the individual reform efforts to the teacher-training curriculum at each of the sites while at the same time all groups work together toward the same goals. At each monthly meeting, participants left having learned something about integrating technology into their teacher preparation program. Each of the models has demonstrated the importance of involving all stakeholders in the process of integrating technology into teacher and administrator preparation programs. That is, cooperating teachers, college

faculty, administrators (at both the college and K-12 level) and the students, all need to "buy into" the importance of technology in the classroom and school.

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A Technology Infrastructure for Teacher Education

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Today's colleges of education and systems of teacher development do not adequately prepare teachers to use technol ogy in their teaching or in their own professional development. The Office of Technology Assessment (OTA, 1995) reported on technology in teacher education and noted significant limitations: 1) faculty do not model the technology, 2) students learn about technology, not with it, 3) field experiences are not designed to model the use of technology, and 4) technology is isolated from the main curriculum and pedagogy of teacher education. The OTA report identified some promising new approaches being used in a few teacher education programs, but new models of preparing teachers for learning and teaching in an age of technology need to be developed.

The need for improved teacher preservice development programs is heightened by the realization that half of the teachers who will be teaching in 2005 will be hired over the next decade and this large scale hiring will continue over the following decade (Gerald & Husser, 1991). In a briefing paper for the National Commission on teaching & America's Future, Linda Darling Hammond (1996) illustrates how this is a critical historical moment for transferring the capacity of the American teaching force by transforming the quality of their preparation.

This paper describes an innovative technology infrastructure for teacher preparation in a land grant university that is committed to a vision of a technology using educator, and has made a substantial investment n reform and infrastructure.

Background

In 1993 the University of Missouri (MU) College of Education (COE) made a commitment to a vision of a teacher as a reflective and inquiring professional. The new undergraduate teacher development center (UTDC) was designed through a collaborative process with school districts and members of the government and business communities. The COE has restructured the teacher preparation program to focus on field-based inquiry and reflective practice as two key methods for teacher development. Freshmen in the 1996-97 academic year were the first cohort to undertake this new UTDC program. This commitment to an improved COE undergraduate program is taking place in the context of a university-wide commitment to improved undergraduate education. For example the MU undergraduate general education program received the 1997 Theodore M. Hesburgh Award from the American Council of Education, and NSF has recognized MU along with nine other universities as a research-intensive university that has made a substantial commitment to integrate research and education for undergraduates.

The new UTDC is also based on a second commitment to produce a new generation of educators who can help achieve higher levels of learning utilizing modern information technology. A key aspect of the new program is the inclusion across all phases and components of the UTDC of outcomes for the ability to use technology. Perhaps even more significant is the investment of $3.4 million by the University to build a learning community enabled by a technology infrastructure, to develop new teachers who become users, advocates, and life-long learners of technology.

Described below, the technology infrastructure for the UTDC includes: 1) developing a set of technology competencies for teacher education majors, 2) having each student possess a laptop computer to insure high levels of access to technology, 3) providing faculty with advanced technology, 4) connectivity between the COE and partner school districts, 5) using electronic tools to capture, share and reflect upon experiences, and 6) creating new forms of support for using technology. The COE envisions a community of educators enabled by advancing technology for shared and continuous professional development. For example, the Interactive Shared Journal System that allows preservice teachers to capture and share their experiences can also be used by inservice teachers to reduce the isolation of teaching and bring the resources of the education/learning community to bear on the problems of practice.

Key pieces of the technology infrastructure

A set of technology markers

Markers refer to milestones or achievements expected of the student. They refer to objectives for the technology

competencies and knowledge of the undergraduate teacher education student. These markers are expected to evolve and grow as the faculty gain experience in supporting students to achieve them and as the technology infrastructure grows and improves. The markers are intended to provide a solid beginning for a lifetime of technology use and continued professional development. They emphasize that technology is a means to valued, shared goals of the program: communication, diversity, and inquiry. All phases and components of the UTDC have technology markers that are expected to contribute to the following principle and goals:

Effective teachers use technology to participate in a community for professional development, to engage in personally meaningful inquiry, and to support teaching, learning, and assessment with their students.

1. Use technology to communicate with others, share information, reflect, and engage in professional development.
2. Integrate technology in managing and facilitating instruction, assessment, and learning.
3. Use technology for inquiry in content areas across the curriculum.
4. Explore existing and emerging technologies to determine their potential usefulness.
5. Expand students' experience and understanding of multiple perspectives through use of technology.
6. Examine the educational, ethical, political, and cultural implications of technology

Personal computers for teacher education students.

Apple Powerbook 1400's were provided to all 270 freshmen in the class of 2000 and to all 30 faculty implementing the first phase of the UTDC. A similar number of freshmen and faculty have received powerbooks for the class of 2001. The UTDC program has been designed with the expectation that students will have technology competencies and technology capabilities. In order to achieve the high expectations for student outcomes as represented by the markers, it became apparent that individual students each need a mobile and powerful system. To this end each member of future freshman classes will receive a personal laptop computer. The plan is to replace the student computers after 2.5 years with the most current and appropriate version available.

Support for using technology

The Reflector is the COE laboratory and support system for applying learning and technology innovations. The Reflector is a learning and performance support center that integrates interactive networked technology with traditional media resources. In most colleges, the Reflector would be called the media center, but the Reflector has been designed around the goal of developing a reflective professional educator. An essential role of the Reflector is to connect practicing educators with preservice teachers, in virtual and actual settings, thereby enabling today's and tomorrow's educators to exchange experiences, challenge assumptions and test ideas. The Reflector also includes a team of Learning and Performance Support (LAPS) specialists who provide learning and support on an as needed basis, with the belief in right-time, right-place, right-form support.

Interactive Shared Journal System (ISJS).

The ISJS is an Internet-based tool developed in the COE for enabling students to create journals about field experiences and share these journals with other educators in their community of professional development. ISJS integrates a set of Internet-based tools, such as web browsing, e-mail, and chat, with the shared journal tools to create an advanced system for supporting learning from field-based experience. The ISJS will be a core technology for supporting the teaching and learning experiences of the UTDC and will be integrated into most courses as well as for connecting preservice teachers with the experiences of inservice teachers. (Laffey & Musser, 1997 & 1996).

Connections with Schools.

The COE has formed a partnership with 19 school districts around the state of Missouri, who form a web of emerging professional development schools. The COE has invested in building a telecommunication system to connect with these schools so that preservice teachers and inservice teachers can form a community for professional development. These connections are just getting underway, but several projects represent tests and prototypes for how the community can develop. The test projects include Project MOST (an NSF/NIE award) http://tiger.coe.missouri.edu/~most/index.html and Project Whistlestop (a Department of Education Challenge Grant award to a consortium of several partner schools) http://whistlestop.org .

Implementation of the Technology Infrastructure

Three short case reports will be used to describe how the technology infrastructure is influencing teaching and learning in the college of education. In preparation for these case reports consider two extremes of design. On one end of the spectrum, goals and objectives are set, designers specify pathways from a current status to a desired end, evaluation measures are put into place, and a master plan is executed to systematically eliminate or minimize the prospect of error. This traditional design type works well in steady state environments, where there is a core of experience, and outcomes are predictable. On the other end of the spectrum is an approach called rapid prototyping, where mistakes are expected and lessons are rapidly learned and turned into system improvements. Rapid prototyping is used in organizations when speed to market is essential and when

key parts of the system are novel and the impact is unpredictable. Our approach to implementing a technology infrastructure required both types of design processes. When you are handing out three hundred laptops to freshmen you need to think through a process of installation, testing, and start-up that is efficient and minimizes confusion. You cannot anticipate every problem that will arise, but based on experience you can plan for a certain number of systems that will fail, a number of students who will need extra help, and a need for custom settings and configurations to minimize the level of expertise needed by students to get started. However, you cannot anticipate the degree to which faculty will appropriate technology into their curriculum or what type of support they will need as they start to envision listservs, web pages, mediated presentations, and uses of custom software. You need flexibility to adapt and adjust as opportunities or challenges arise.

Support, Support, and more Support

In less than a four year time span the college of education has moved from classroom and lab access of about 40 computers and less than 100 computers in faculty and staff offices, to approximately 1800 computers in various capacities of use in the college. To support this rapid growth in computer access and use the LAPS team was created and has grown to 6 staff members. In a given month the team logs approximately 300 e-mail and phone work orders. In addition to fixing computers, installing software, and troubleshooting network problems, the LAPS team provides training and specification for new equipment. A system administrator provides a network of listservs, e-mail addresses, webpage maintenance, an other sharing services.

An instructional materials center that historically provided access to materials required by instructors has been transformed into the Reflector. The Reflector is open 7 days a week and provides access to computers in a context of multi-media tools, printers, network and Internet services, and high levels of support from a customer-oriented staff. A typical month in the Reflector has over 20,000 users. The physical space of the Reflector has been designed not as a place of computing, but rather as a place of work and learning that is supported by computing. There are multiple types of spaces facilitating collaboration, production of artifacts, and use of multiple resources including books, computers, and people.

Internet-based Shared Journals

The teacher-education faculty designed a new curriculum emphasizing learning from field-based experience with the goal of developing reflective practitioners. Student use of journals to share their experiences and thoughts has been a commonly used tool for many years among many of the faculty. With a vision of a technology infrastructure providing high access to computing, curriculum goals emphasizing learning from field-based experience, and a shared value among faculty of learning through the use of journals; a software development team created a client-server environment for students and faculty to report, share, and reflect through an interactive, internet-based, shared journal system. The most common journal assignment in the first year has been a faculty assigned task, such as visiting a school site and observing a student or classroom and then reporting on the observation. Faculty then read the journals on-line and have the capability of writing appends (an attached journal entry) to the student entry. Some faculty have encouraged students to share journals by asking them to read and append to fellow student journals.

The use of the journal system has been one of the most challenging features of the new technology infrastructure. On the one hand many faculty and students have appropriated the tool to enhance the way they communicate and make sense of their experiences. Some faculty are developing innovative designs for curricular use, such as creating a journal environment for virtual students, wherein the teacher education students would build a virtual school and describe experiences through the eyes of virtual k-12 students. Similarly, in focus group sessions, students have discussed how the journal, since it is a tool they will use throughout the teacher education program, will help them to look back over their experiences facilitate a better understanding of new experiences. Students have also discussed reviewing entries made by other students to help understand observations they are making in classrooms. On the other hand, however, some faculty are reluctant to use the journal system. There are several reasons for this reluctance, including other preferred ways of working, limited experience with technology, technical problems of the network and journal software which have made it unreliable at times, and just being overwhelmed with all the other programmatic changes.

Mobile Laptop Program

Putting computer technology in the hands of all students and faculty is a technical, social, cultural, business and political process. Our process included testing several potential platforms for supportability and functionality, testing all of the possible system peripherals, developing the program-specific software configuration that replaces the initial Apple configuration, developing mass production systems in order to update each system, and providing training sessions for laptop use. In addition, the process included orchestrating the related business endeavors to purchase, finance and secure the systems. The selected systems include:

Hardware:

- Macintosh Powerbook 1400cs
- 16 Mb RAM expandable to 64Mb, 750Mb Hard Drive
- Internal 6x CD-ROM and floppy disk drive
- 800 x 600 Color Display
- 33.6 Modem/Ethernet PC Card

- 133 Mhz with level two cache high performing chip
- Built-in infrared technology
- Customizable Book Cover
- Shoulder or Backpack Carrying Case

Software:

- Claris Works (integrated word processor, drawing program, database, communications program, and spreadsheet)
- Claris Organizer (schedules and contacts tracking)
- Apple Internet Connection Kit (Netscape Navigator, Claris E-mailer Lite, Fetch, NCSA Telnet and NewsWatcher)
- MU Internet Suite (a supplement for the Apple Internet Connection Kit)
- Apple Remote Access (For connection to a desktop or network from a remote location)
- Macintosh Easy Open and DataViz Easy Open (translator for reading and writing PC-formatted floppy disks and PC-formatted files)
- Interactive Shared Journaling System (multimedia journaling application supporting communication among students and faculty in local and remote locations)
- Eudora Pro (user friendly E-mail application)

Early lessons

Many of the lessons learned in the first year can be placed into three categories: technical, access/usage, and curriculum integration.

Technical. Meeting technical challenges provides a foundation for usage and curriculum integration. To a great extent most of the technical components of laptops, software, servers, and networks are well understood, and one could model a technical plan after those used by other organizations. Two of the key drivers for the technical plan were ease of use and mobility. Since many of the students and faculty were essentially novice users of technology, and much of the value of the technology infrastructure was driven by network access, it was important to make networking simple. However, since the students and their laptops were mobile networking was complex; access needed to be supported from within the college of education, in the dorm rooms or in a k-12 school. A custom configuration of network tools and settings were installed on each laptop. Similarly, custom tables were created to make it easy for students during class or in the Reflector to connect to the campus network. This system, however, proved too fragile and students frequently were confronted with error message or unexpected outcomes of trying to make network connections. Problems included: inadequate dynamic allocation of IP addresses, user confusion about when to use the modem or the ethernet adapter, faulty cables, unreliable software, inadequate training of students for what to do when an error occurred, and difficulty in updating software on the laptops when a problem was diagnosed and corrected. Planning the technical installation and resolving problems consumed great amounts of energy and mind share during the first year, but one can look at the technical features of the system and see that technical hurdles are becoming manageable. The combination of technical solutions and a more experienced community of users is progressing toward a sound and effective technical implementation.

Access/usage.

A somewhat naive conception is that access to the technology will inevitably lead to appropriation of the technology. In many ways this simple notion is being borne out. But, a more powerful notion of access sees it framed in a set of conditions, such as to what end and enabled by what support. Access to an appropriate form of support may be nearly as critical as access to the technology. While some forms of group training are required by the need for efficiency, most of our efforts to develop competency are moving away from training models and toward support models. To the extent possible we are designating a technology support person for most groupings, encouraging buddy systems, extending hours of the reflector, creating self-paced explanations and skill building, and leveraging competencies developed by one set of students to facilitate the next set of students. These types of activities need to be planned and coordinated, but in a certain sense they are also organic. As our community becomes more densely populated with competent technology users the process of inducting a next cohort should become easier, just as learning a foreign language is easier if you are among people who speak that language naturally and frequently.

Curriculum Integration. Curriculum integration means both the use of technology as a key component of the curriculum and of changing the curriculum because of what technology enables. Clear progress is being made by many faculty on the use of technology in their curriculum. Like many other newly introduced technologies the technology infrastructure and the journal system in particular are at first being used to replicate existing patterns of work, primarily communication between the teacher and student. As faculty become more experienced with the tools, they start to see other benefits and possibilities, such as the virtual school and collaboration among students mentioned earlier. One initiative underway is to use the journal system to connect preservice science teachers with high school students involved in project based learning. The high school students use the journal system to report on their project work, and the preservice teachers use the journal to "observe" project based learning. One of our science education faculty has developed a methods curriculum that has the science education students use the journal to facilitate moving through various roles of observer, mentor, and teaching assistant for the projects underway in the high schools. The

asynchronous nature of journaling and the Internet wide basis of the journal facilitates connecting preservice teachers to innovative k-12 experiences wherever they may occur across the state.

Conclusion

There is no silver bullet for bringing the benefits of advancing technology to bear on improving teaching and learning. However, a technology infrastructure that enables preservice teachers to learn in a context of computing and network services seems fundamental to developing attitudes, values and competencies for making technology a tool of teaching. The technology infrastructure cannot simply provide lessons about using technology in curriculum, it must enable teachers to learn to use technology for continuous professional growth and development. The technology infrastructure of the College of Education at the University of Missouri, while no doubt still under construction, is a substantial step towards understanding how to build and support a technology infrastructure and towards providing beginning teachers with powerful new conceptions and tools for using technology as a part of their learning and teaching.

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THE TEACHER EDUCATION COMPUTER LAB: PLANNING, DEVELOPMENT AND MANAGEMENT

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Martinson Middle School

The identification of the need for a teacher education computer lab at Eastern Nazarene College was rooted in (1) the authors' intense technology-based professional development experiences as registrants in the Lesley College M.Ed. Outreach Program in Computers in Education, (2) the authors' perceived need for a facility in which teacher education students could experience immediate technology applications of the content of their curriculum and methods courses, and (3) the passing of the 1993 Education Reform Act by the Massachusetts Legislature.

In the fall of 1992, the authors enrolled in the M.Ed. Outreach Program in Computers in Education located in Orleans, MA. Lesley College offers this program in various sites across the country. Instructors are practitioners in K-12 settings and Lesley full-time faculty. Throughout this program the authors became familiar with the many ways in which technology was being integrated into K-12 programs. They experienced, first hand, the powerful instructional impact of multimedia, the value of student-instructor e-mail capability, and the ways in which the Internet could be used as a valuable research tool in professional education and in all of the academic disciplines.

In 1993, Dr. Shopland was asked to teach the undergraduate and graduate courses in educational technology in the Division of Teacher Education at Eastern Nazarene College. After reviewing the "standard" course outline, it was apparent to her that the courses were in need of significant revision. Heretofore, the courses had treated the traditional "audio-visual" learning tools. It was essential that students and teachers of the 90's also become knowledgeable of the use of computer-based learning tools. During the '92 - '93 and '93 - '94 academic years, videos and journal articles were used to introduce students to the uses of computer-based learning tools.

Even these modifications proved inadequate preparation for tomorrow's teachers. Students and teachers also needed to become skillful in the use of computer-based learning tools. While all students had word processing and e-mail privileges in the Information Technology Systems Mac and PC labs located in the library, teacher education students required a facility in which they could learn the skills they would need as classroom teachers managing the use on in-classroom computers. These skills included learning how to (1) install programs, (2) access the control panels, (3) save to the hard drive, (3) handle minor trouble-shooting with their computers, (4) develop multimedia instructional materials, (5) use the Internet as a research tool, etc.

In addition they would also need to learn how to integrate computer-based learning tools with the K-12 curriculum. The concept of the teacher education computer lab was beginning to emerge.

The 1993 Education Reform Act, shaped and placed into law by politicians, had called for the integration of educational technology with the K-12 curriculum. This mandate would later serve as a significant factor in communicating to college administrators the need for a teacher education computer lab.

During the '95 - '96 academic year, two events occurred at ENC that provided momentum for the actualization of the concept of the lab. Professor Kannegieser was employed as an adjunct to assist with the teaching of graduate educational technology courses, which had grown in enrollment in the past three years from 10 students to 26. She worked closely with the Information Technology Department in making the ITS computer labs located in the library more user friendly for education students. Several pieces of educational software became available to students in the lab. Teacher education students were also provided with password access to the Internet. While teacher education students were now able to access computers for professional and course-related purposes, it was impossible for the authors to conduct class in the ITS public use labs.

The building momentum toward a teacher education computer lab was strengthened by the purchase of a $6,000 Proxima computer projector by the Mathematics and Computer Departments for use in their courses. The authors requested and were granted use of the projector in their

courses in educational technology. The projector was very helpful in demonstrating educational software, teaching students how to use various tool programs, and how to navigate the Internet.

Communicating the Need for a Teacher Education Computer Lab

The course in educational technology was significantly revised in 1993 with a new text, videos focusing on computer-based learning tools, and assigned readings in current journals treating the integration of computers with the K-12 curriculum. The instructor's dissatisfaction with the lack of educational software and hardware to enable a much needed "hands on" instructional methodology motivated her to communicate with the key decision-makers regarding facilities and technology planning for the college. These decision-makers included the Chairman of the Division of Teacher Education, the Director of Information Technology Systems and the Vice President for Academic Affairs. The developing concept of a computer lab in which curriculum and methods courses could be taught was first brought to the chairman of the Division of Teacher Education. Fortunately, he was a self-taught computer user who was an e-mail and spreadsheet enthusiast. He accepted and supported the concept and referred Dr. Shopland to the college's Director of Information Technology Systems. Convincing the ITS Director of the value of such a unique instructional space was not an easy task. Certainly, he believed in the value of computers as learning tools. He was not easily convinced of the need for a computer lab designated for the exclusive use of teacher education courses, students and faculty. The key "selling point" for him was the evidence of a significantly growing market for professional development courses and programs in the greater Boston area, which was the direct result of the '93 Massachusetts Education Reform Act.

Once convinced of the need for the facility, the ITS Director has been a significant supporter of the work of the Education Division in regard to program development in educational technology. A meeting was held with the ITS Director, the Chairman of the Division of Teacher Education and all members of the education faculty to discuss the concept and affirm joint support for its actualization.

Planning the Teacher Education Computer Lab

The Director of ITS worked closely with Dr. Shopland in designing a technology-based instructional facility which could serve as a model in the greater Boston area. Included in the design was the equipment essential to host and participate in professional video studio conferencing and individual computer-based video conferencing. In addition, 15 multimedia computer stations, and a variety of peripherals would be purchased. The original plans were later modified in accord with actual funding.

Funding the Teacher Education Computer Lab

The momentum of administrative support had begun to grow. The Director of ITS worked with Dr. Shopland in developing a $240,000 grant proposal which was submitted, with a letter of support from the President, to a private foundation in the Spring of 1996. Unfortunately, the grant was not funded.

An unexpected letter from a local area kindergarten teacher arrived on the desk of the President in the spring of 1996. Introducing herself as an alumna of the college, she noted she was using five computers in her own classroom and was concerned about the college's preparation of future teachers in regard to their ability to effectively use computers in their classrooms. She further informed him that she had visited campus to learn about the college's efforts in this vital area of teacher preparation. She had been very disappointed to learn that little was being done to provide teacher education students with significant access to computers and current instructional software that they would be using in their K-12 classrooms. This letter "turned the tide" with regard to the college's interest in funding the project. By the fall of 1996, the Vice-President for Academic Affairs was planning to include the needed funds in the college budget for '96 - '97. However, he indicated he was considering allocating $25,000 in capital expenditures to equip a teacher education computer lab. We were pleased with the college's commitment, even though it represented only ten percent of the funds we deemed necessary to develop a "model technology-based environment."

Developing the Teacher Education Computer Lab

The Director of ITS, Dr. Shopland, and Prof. Kannegieser developed the following list of hardware to be purchased with funds that became available:

10 Power Macs
1 Hewlett Packard Laser Printer
1 Hewlett Packard DeskJet Color Printer
1 Apple Color Digital Camera
1 Apple Color Scanner
2 Connectix Quick Cam Video Cameras

Software purchases were severely limited by lack of sufficient funds. However, each system was preloaded with Claris 4.0 and ITS added Netscape and NCSA Telenet. Five copies of the Apple Elementary CD Resource Bundle and five copies of the Teacher CD Resource Bundle were purchased. Additional software purchases were limited to five additional copies of Hyperstudio and five copies of MicroWorlds.

Funds were not available to set-up a stationary instructor demonstration station which would include a computer projector. This is a significant limitation of the teacher

education computer lab at ENC. Instructors must use a portable demonstration station/projector available to all departments and scheduled via ITS. Unfortunately, reservation conflicts are not carefully monitored, and instructors cannot rely on the "reserved" availability of the college's only computer projector.

The teacher education computer lab was opened in the fall of 1996. During the first semester of conducting classes in the lab, it became apparent that each system should also be equipped with a Zip drive. The multimedia projects being developed by students required much more memory than the 1.4-MB available on a floppy disk.

Ten Zip drives were purchased and installed for the Spring Semester, 1997 and students were required to purchase a Zip cartridge. Spring Semester, 1997 students reported significantly greater lab-user satisfaction than did Fall Semester, 1996 students.

Managing the Teacher Education Computer Lab

The effective use of the teacher education computer lab by students and faculty is dependent upon effective management of the lab. The effective management of the lab requires an institutional financial commitment to fund the part-time or full-time position of Director of the Lab. The Director has many responsibilities including (1) scheduling open lab times, (2) scheduling of student lab assistants who monitor the lab during open lab times, (3) training of student lab assistants, (4) development and updating of the lab handbook, (5) follow-up with students regarding log entries noting hardware and software problems, (6) trouble shooting, (7) communication with individual instructors regarding their requests to use the lab and special programs, (8) installation of programs requested by individual instructors, (9) communication with facilities management regarding cleaning and appropriate maintenance of the lab, (10) communication with ITS to request additional technical assistance, and (11) monitoring legal uses of software in the lab.

Faculty Orientation to and Training in the Lab

Voluntary small group and individual orientation to and training in the lab has been provided. All faculty members have attended an initial session. A few faculty members have requested individual training in e-mail and the Internet. No faculty members have requested individual training in the use of multimedia and other tool programs. In addition, no faculty members have requested information related to instructional software that would be appropriate to the courses they teach. While faculty members have been supportive of the design and implementation of the lab, they have not utilized it as fully as was hoped. Faculty survey results have shown that the instructors who do use the lab extensively in their curriculum courses are also the instructors who teach the undergraduate and graduate courses in educational technology. In retrospect, it may have been wise to include the entire teacher education faculty in the planning of the computer lab. Their engagement in this process may have prompted them to develop a stronger commitment to more effectively utilizing the lab in their courses.

Recommendations for Utilizing a Computer Lab in Teacher Education Courses

The recommendations noted below are made in regard to the utilization of a computer lab in curriculum and methods classes, and all other teacher education courses.

In curriculum and methods courses, and other education courses, instructors may use the computer lab to:

1. demonstrate how to adapt a student's use of a particular piece of software to the learning styles and needs of various students,
2. engage students with a particular piece of software using a cooperative learning approach,
3. demonstrate how to integrate subject specific instructional software with a constructivist approach, discovery approach, investigative approach, or direct teaching approach,
4. introduce students to various pieces of instructional software to engage the learner's higher order cognitive skills,
5. introduce students to various pieces of instructional software to engage learners' multiple intelligences,
6. demonstrate various pieces of instructional software engage learners in the "process" of a specific discipline,
7. introduce students to various pieces of instructional software to facilitate the development of learner's writing, reading and speaking skills,
8. navigate the Internet with students,
9. demonstrate how to use the Internet as a research tool,
10. e-mail other professional educators who have published on the Internet,
11. conduct videoconferences with other educators,
12. enable students to share their research with classmates via e-mail,
13. enable students to provide each other with peer feedback regarding course projects,
14. develop K-12 multimedia instructional materials with students,
15. identify K-12 educators with similar professional concerns, and
16. assist students in publishing their own work on the Internet.

This is merely a beginning list of recommendations. Each instructor who makes a meaningful commitment to utilizing computer-based technology as a learning tool in

teacher education courses will be able to add many recommendations to this list.

Acknowledgements

The authors wish to thank the many individuals who have worked to make the teacher education computer lab a meaningful reality on the campus of Eastern Nazarene College. Dr. Robert Kern provided the initial acceptance and support for a teacher education lab while serving as Division of Teacher Education Chairman. Dr. James Knox, current Chairman of the Division of Teacher Education, Professor Lois Knox, Chairperson of the Department of Education, Dr. Paul Nyce, ITS Director, Dr. David Kale, Vice President for Academic Affairs, and Dr. Kent Hill, President, have all provided significant support of the teacher education computer lab.

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Collaborative Distance Learning Research for the Phi Delta Kappa National Values Project

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Students in the Educational Leadership Department of the University of Texas at El Paso have been invited to help direct research efforts in high schools throughout the nation as those schools move ahead with the Phi Delta Kappa National Values Project. Under the leadership of senior researcher Jack Frymier, Phi Delta Kappa conducted a national study entitled *Study of Core Values and the Schools*. In the subsequent 1995 publication, Frymier and his fellow researchers described seven core values identified as important to most people and essential to be taught in schools. These core values were : 1) learning, 2) honesty, 3) cooperation, 4) service, 5) freedom, 6) responsibility, and 7) civility. In addition to the publication, the study also produced a recommendation that Phi Delta Kappa seek external funding to establish and maintain a League of Values-Driven Schools.

The League of Values-Driven Schools

During the Autumn of 1996 and the Spring of 1997, Frymier visited high schools throughout the country, seeking to establish a league "comprised initially of 100 or so high schools in which teachers, students, administrators, and parents make a commitment to develop a values-oriented program of study in their school, focusing on one or more values every year from the seven core values" (Frymier, J., et al., 1995). Research teams would conduct in-depth research, then share their findings with other participating schools through newsletters and a summer conference for selected students from each participating school. Principals would be expected to lend both material and moral support and would be personally involved with other principals in both the planning and monitoring phases of the collaborative national project.

Phi Delta Kappa agreed to work directly with participating schools to develop and share materials and experiences that proved effective in addressing values issues. The main thrust of the project would be to incorporate values into each school's curriculum and culture in a meaningful and positive way so that students would develop the abilities to: (1) deal in an ethical manner with complex challenges and dilemmas new to the human condition; (2) apply sophisticated knowledge and skills to daily living and occupational tasks; and (3) function successfully in a technologically complex environment.

The Phi Delta Kappa Chapter of the University of Texas at El Paso (UTEP)

Representatives from the UTEP Chapter of PDK attended the initial meetings held by Jack Frymier for potential league high schools. The broad scope of the envisioned research and its logistical realities concerned many of the principals in attendance. Many felt that they needed outside local assistance to carry out the proposed research projects and some formal mechanism to share both ongoing research efforts and the findings of successful projects. The UTEP Chapter of PDK had been searching for a way to return to its original mission of supporting research and providing service to its community and schools. Chapter officers decided to visit PDK International in Bloomington to explore avenues of collaboration that might serve both local El Paso needs and the demands of the national league effort.

As a result of these meetings, the UTEP Chapter agreed to serve at several levels. First, it would seek assistance from graduate students in UTEP's Department of Educational Leadership and Foundations. These graduate students would be assigned to specific schools to act as catalysts and facilitators for campus research efforts, so they might use parts of the research for their masters theses and their doctoral dissertations if they chose to do so. Their involvement in this project would also reflect their commitment to values-driven education in general. These students would expand their opportunities to engage in a variety of learning communities which value: (1) the intrinsic worth of learning something well, (2) the connections between what students are learning and understanding themselves in the world, and (3) the excitement of exploring that world with others (Sergiovanni & Starratt, 1993).

Second, the UTEP Chapter would establish and maintain an Internet web site whose primary purpose would

be to provide a collaborative forum for league activities. This site would be directly linked to the main PDK International site, as well as to all other known PDK chapter sites throughout the country and any sites that might be established by participating league schools. Thus, research experiences would not be limited to conventional means, but would include opportunities to utilize such innovations as distance learning, internet activities, and field studies. Brownell (1997) notes, "The content of educational technology has changed over the last decade from hardware and programming for teaching of computer studies to the use of technology to enhance educational and professional studies." These technological advances present new challenges and advantages for graduate researchers and other league participants.

Third, the UTEP Chapter of Phi Delta Kappa would reorganize in ways that would maximize its ability to service the league project. For instance, the officer position entitled "Research" would be elevated to vice-president rank, with several assistants assigned to coordinate local and national research efforts. A position entitled "Director of Technology" would also be established along with the appropriately appointed assistants to build and maintain the web site.

Recruitment of the graduate students began with those who were already members of PDK. An Ed.M. student and an Ed.D. student volunteered immediately to conduct their thesis and dissertation research in the core values area. Several other students, who were not yet at the thesis or dissertation stage, agreed to act as facilitators in the high schools. They assumed that their values research would eventually evolve into personal research studies.

The values research project offers opportunities for adult learners to participate in activities which "facilitate optimal learning and growth" and will allow them to: (1) be involved in the determination of their learning activities by setting learning goals, content, experiences, and evaluation; (2) be considered as individual learners, bringing a varied background of experiences and knowledge the learning situation; (3) see the values of the learning experiences in knowing that the activities and experiences will be applicable to their work; and (4) see tangible outcomes from the learning activities and experiences, thereby receiving some acknowledgment of their personal achievement toward learning goals (Webb, Montello, & Norton, 1994). The benefits to student researchers would be maximized within supportive professional and educational environments.

Possible next steps

Since UTEP shares the border with Mexico, many students expressed an interest in replicating the original values study in Mexico. Conversations with education officials in Ciudad Juarez and in the State of Chihuahua confirmed that Mexican schools would be very interested in joining the values project, not only from the viewpoint of the study, but also as members of the League of Values-Driven Schools. Sergiovanni (1996) notes that "centers of inquiry foster the sense of community by encouraging discourse among teachers." One of UTEP's great advantages lies in the bilingual abilities of many of its graduate students, which optimizes communication opportunities. Thus, collaborative efforts over the Internet could be both bilingual and bi-national and could provide a solid basis for comparative studies of the values embedded in the high schools of both nations, further encouraging inquiry and research and expanding learning communities.

A second possibility resides in the desire of many local middle and elementary schools to become meaningful players in the league. The web site and ongoing e-mail communication eliminate the need to transport students in order to facilitate collaboration. Thus, distance education has opened doors to the involvement of new league players.

Because of the asynchronous nature of the Internet communication, people who would not be available to work with students during the school day can be called upon as resources and fellow researchers. This could include people halfway around the world as well as those in a neighboring city.

The PDK values project offers opportunities for educators to collaborate in research about values education through technology. The PDK websites, e-mail, the Internet, and other databases provide immediate access to a variety of useful data pertinent to the values research project. Such technology can enhance educational and professional studies and facilitate conversations which create, sustain, and expand a "community of research practice" (Sergiovanni, 1996) at local, regional, national, and international levels.

Call for participation

We would encourage anyone who sees a way to add something to the league efforts to contact the UTEP Chapter of PDK . Project coordinators will attempt to fit your contributions into the national project. Primary contacts can be found on the web site at http:// pdkutep.org/

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Historic Pittsford Website - Time travel through our town

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The Historic Pittsford Website - Time travel through our town is a project done in partnership with several groups. Its purpose is to provide students and the community at large a virtual source for the history of the town of Pittsford as it fits into the greater scheme of the region and state. It is particularly valuable for fourth grade students as local, regional and state history is the focus of the social studies curriculum in New York State. The Pittsford Central School staff is also interested in sharing this site and learning about similar efforts in other communities so that linkages can be set up and communities can learn from each other.

Historic Pittsford Website Designers

The design of the Historic Pittsford Website is a partnership of three groups. One is the Pittsford Central Schools Social Studies Standards effort, chaired by Peter Pappas, Social Studies Standards chairperson. Another is the Jefferson Road School fourth grade parents, staff and students. Finally, Mrs. Elisabeth DeGironimo, GIS web consultant at Phoenix Systems & Technology, has designed and produced the actual site.

Historic Pittsford Website Development

The project originated with Mr. Peter Pappas, who through numerous contacts with Historic Pittsford and town officials, linked the fourth grade team at Jefferson Road School with source materials and people for a school project on the history of Pittsford, entitled the Spiegel Project. After a meeting with fourth grade staff, Elisabeth DeGironimo, web consultant at Phoenix Systems & Technology and Mr. Pappas in August 1997, the Historic Pittsford Website project was launched.

Parents were given an initial overview of the project in October 1997. They were then assigned computer lab time periods to come to school and scan photos, maps, and pictures for the project with students. At the same time, Mrs. DeGironimo designed the site and its structure. A database was set up to catalogue the images into the various categories. Students will be adding original material, including interviews with Pittsford officials and business people, reports and multimedia projects.

The Historic Pittsford website is in a GIS format and programmed in HTML. The site has three levels:

- Local - data about the town of Pittsford.
- Region - data about the city of Rochester and Monroe County
- State - data about the state of New York

Users are able to zoom in and out of a location from the three levels and gain a perspective of the relationships among the different geographic levels.

The site also is divided into four areas within the levels:

- Land - data about homes, farms, geographical features of the respective areas.
- Enterprise - data about businesses in each area.
- Community - data about churches, schools and other civic organizations.
- People - data about people at each of the levels.

As with many websites, this one is in its genesis and will continually evolve and be under construction. Future plans call for the inclusion of aerial photos, QuickTime VR movies, and multimedia projects by students.

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THE ELECTRONIC STUDIO AND THE INTRANET: NETWORK-BASED LEARNING

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The deployment of a learning environment requires the development of two components: (a) a guiding philosophy and (b) a system that supports the philosophy in practice. The Electronic Studio is a distributed learning environment based on constructivist and constructionist ideas as explained of Papert (1993), Negroponte (1994) and Resnick (1994, 1996). In the Electronic Studio the support system is provided by a network based computer system. Papert (1993) has argued that people learn more effectively when they are engaged in the creation of objects that are relevant and meaningful to their lives. In this process, students learn more by creating an object after designing its parts than by taking apart something that is handed down to them (Negroponte, 1994; Resnick, 1994). This, by definition, is a problem oriented instructional environment. The characteristics and advantages of problem based learning have been reviewed by Blumfeld et al. (1991). A technologically enhanced system based on a network can support this project-based approach helping learners to solve problems in a collaborative fashion and facilitate the process beyond the confines of space. This makes it possible to extend the notion of constructionism to distributed constructionism, a situation where people who are not working in close physical proximity can collaborate in creation and construction (Resnick, 1996).

This is an overview of how the Electronic Studio concept, developed by Rice University's Center for Technology in Teaching and Learning (CTTL) can serve as an environment in which project based learning can flourish by facilitating construction, collaboration and sharing of projects and information objects. See (http://cttl.rice.edu). The Electronic Studio has gone through several iterations. The initial phases of the current iteration have been developed and deployed at this point. Other aspects are still under implementation.

Electronic Studio

The Electronic Studio is the result of CTTL's System-After-Next vision for technology where people, processes, and technology are integrated (Gorry, 1997). The Electronic Studio serves a number of purposes, all focused on the construction and development of projects. It is a workplace, a display area and a repository for tools, data, multimedia, design projects, and personal papers. But because of our use of networking, an Electronic Studio is not bound to a single place. Learners, linked together by a telecommunications network, can work simultaneously within a studio to share notes, assignments, documents, images, video, and sound.

An Electronic Studio provides a unified front for access to remote information sites. For example, students can access information from libraries, and gain access to databases around the world; or students can view the resources at a museum and interact with its curators. Electronic Studios allow groups of learners from different environments to collaborate in the development and exploration of curricula. It permits two way interactive video discovery and enable learners to become builders of common knowledge bases by creating shared repositories of information.

The distributed nature of the Electronic Studio depends on the development a networking infrastructure. That infrastructure enables uses of computing that go beyond the single student to foster the sharing of educational resources between teams of learners and individuals. Because of its nature, the Electronic Studio is a great system for student centered learning, as discussed by Norman and Sphorer (1996), where groups can be engaged in active exploration, construction and problem solving.

Design process

The Electronic Studio concept does not focus on a static environment. It is an environment that is constantly transforming due to of changes in technology and in user interests and needs. Therefore, the development of an Electronic Studio project follows an iterative prototyping approach (Gorry, 1997) with significant involvement of the target population. At the project site, consultation with the users takes place so that their needs and concerns are addressed.

Sample Projects of the first iterations

The Center for Technology in Teaching and Learning has been supporting and developing Electronic Studios at Rice University and at The Rice School/ La Escuela Rice, a k-8 educational institution. These developments have been centered on the creation of rich World Wide Web resources that serve students and instructors as centers for information delivery, exchange and communication. One such endeavor is The Galileo Project at Rice University (http://es.rice.edu/ES/humsoc/Galileo/) which was developed as part of a college level course on the life of the famous astronomer.

Galileo's Web (http://riceinfo.rice.edu/armadillo/Rice/Galileo/) was the second iteration of the Galileo Project. In this version, the Galileo materials were adapted to the k-8 learning environment of the Rice School/La Escuela Rice. Using a more integrated environment where learners had access to creative materials through a reduced number of entry points extended the Electronic Studio functionality. A website tied several of the distributed classroom functions together, including reference materials, lesson plans, media collections and display materials. The second entry point was provided by a local area network that provided access to locally stored materials and documents.

The Virtual Villas Project in Galileo's Web represents the kind of projects that learners can develop in an Electronic Studio environment. Here, teams of students designed and built virtual reality villas for Galileo. In the process they learned about the history of science, mathematics and architecture while collecting information and building elements from network repositories and World Wide Web sites (Solís, 1997a)

The Rice University and Rice School/ Escuela Rice Electronic Studio projects relied on two technologies: a) the institutional Local Area Network (LAN) and b) the Internet. The LAN provided teams with distributed, shared spaces for tools and documents, as well as with widely accessible private spaces. The Internet, on the other hand, provided learners with access to information resources and a communication system for remote locations. What these two sites lacked was an integrated access system for information and communication. Users were able to access all the necessary resources through the networking systems, but the process required them to become familiar with procedures and technologies, which were in not necessary for the goals of the projects.

Refining the Electronic Studio – higher integration

In a new iteration, the Electronic Studio is being deployed at Hogg Middle School, an inner city school in Houston, Texas. The Electronic Studio model under development at this site takes advantage of new technologies developed after the deployment of the previous iterations. The technological goal for this model is to create a highly integrated interface and seamless environment to enable learners to concentrate on the creative processes and learning. To achieve this, an Intranet component has been added to the support technologies.

What is an Intranet?

The term Intranet is used here to refer to a local or wide area network based on Internet protocols and designed to serve the internal needs of an organization. It may or not be connected to the Internet and typically includes e-mail, file sharing and other basic network services. One of the advantages of Intranets they can be deployed over existing networks and require very little re-engineering. (Khan and Logan, 1996; Brandt and Nash, 1996).

The main differences are that Intranets offer a single point of entry to network based resources and the focus of the development is on the users of the organization involved, not on the global community. This entry point is a World Wide Web page. The Intranet approach has the potential of impacting learning in an Electronic Studio environment as it can create a seamless working environment for the users. In the same way that students walk into a traditional classroom and can interact with tools and materials to develop projects, the unifying approach of an Intranet allows learners to concentrate on the task at hand letting technological nuisance take a back seat. This aspect was important since the reduction of procedural steps facilitates the adoption of technology in organizations that have not relied on it to function (Solís, 1997b).

Several schools and school districts are already using Intranets, but not under this approach. For example, the Huneme School District and Blackstock Jr. High in Oxnard, California, use an Intranet system for cross-district communications, file sharing and source code implementation (Sowinska, 1997). The Montgomery County Public School system, in Rockville, Maryland, in its "Plan for Educational Technology Implementation: The Global Access Project and Beyond" has established, as part of its core strategies the installation of building wide networks and Internet and Intranet software.

The Electronic Studio at Hogg Middle School

What follows are some projects are already under implementation. These projects take advantage of Intranet technologies such as server based databases and scripts to enable users to participate in a collaborative knowledge base construction to create cross-curricular materials. One of the most important criteria in this area was the desire to enable students and teachers to collaborate in learning, while removing unnecessary steps and fronts in the process.

The Online Personal Journals and The Rainforest Poets

The online personal journals were designed so that students would have a personal writing space that could be accessed at the touch of a button and be worked on from

any room in the school. Other students could read each other's materials from any room in the building and teachers could reply to student and comment on their materials. All this happened within a browser environment. Students and teachers looked at the same interface regardless of where they were or what computers they were using. At the same time, files were saved at designated spots at the click of another button. In the Rainforest Poets environment, users collaborated in the creation on poetry based on tropical rainforest themes, again, using a web based interface, with more concern on collaboration than with technology.

Weather Trackers

The processes of science rely on data collection and analysis within a research framework. The objective of this project was to enable learners to collaborate in data gathering and to create a distributed database that could be used across disciplines to meet the needs of individual learners. Taking advantage of the wide area network, schools in the district take weather measurements at their sites and enter them into a web-based database. The participating students build a raw data source that can be used to test hypotheses in science classes but can also be accessed by other classrooms not involved in the sampling process and used as starting materials for mathematical and statistical investigations. Because the data are raw, many age levels depending on the questions and problems that the learners are interested in answering can use them.

The Book Report systems

This project design was based on previous models deployed at the Rice School/ La Escuela Rice, in Houston. Through a series of web based forms students post book reviews to the web. Using an on line database the materials are sorted according to level of complexity, language and genre. The on line reports are reviewed by teachers but are also used in other content areas such as theater arts to make decision on themes that are of interest to the student population.

Development site

The current development of the Electronic Studio is taking place at Hogg Middle School, in Houston, Texas. This is an inner city school, housed in a building that dates from 1926, serves approximately 1,300 students and has about 80 teachers.

This development of the Electronic Studio is the result of a grant awarded to the school by the Texas Telecommunications Infrastructure Fund. (http://www.tifb.state.tx.us/tif.html). The school, with the participation of teachers, administrators and university advisors, established as its goal to deploy a technological infrastructure to facilitate the integration of curriculum and technology.

Creating the technology environment

Preparing the learners

In the past, this school has in the past used computers in a more traditional ways and had no network access. To implement the Electronic Studio at this site is became necessary to train teachers as well as students.

The training model used with the teachers has been successfully implemented before at other k-12 institutions (Solís, 1977b). During the summer of 1997 sixteen teachers from all content areas and grade levels were trained intensively on the use of network technologies in the classroom. They were instructed in curriculum development in a technology rich environment and participated in classroom discussion that focused on teaching practices. After the summer training, monthly workshops were conducted to allow participants to refresh and update their skills. These teachers are now training other teachers in their teams. Students, on the other hand, learn in this environment through modeling, exploration, construction and by teaching each other. Furthermore, a resident consultant remains with the school and actively participates in the implementation of projects and in the school life in general.

Network Infrastructure

Hogg Middle School deployed, as part of this project, cabling for a network capable of serving 550 clients with the help of volunteers and at risk students under the advice of CTIL.

The school is connected to the district WAN and the Internet by a T1 line. All network transactions are handled through TCP/IP protocols. The network system is supported by a Windows NT® that functions as a resource server, a web server, a file storage system, and as a print server. To handle its web services, the system is equipped with Microsoft's Internet Information Server® (version 2.0 with Microsoft Active Server Pages® installed).

Classrooms

There is at least one networked computer in each classroom. Several classrooms have been set throughout the school with four to twenty networked systems. At the completion of this project each classroom will have at least eight networked computers. Due to a staggered influx of systems into the school and changing policies within the Houston Independent School District, Hogg Middle Schools classrooms are populated with a mixture of Apple Power Macintosh® and Windows 95® systems.

Essential to the implementation of the current Electronic Studio model is the uniformity of system configurations. Additionally, applications are carefully chosen, selecting those tools that show a high level of integration with each other. This is what enables learners to share in the production of information objects, regardless of where they find themselves in the schools. Therefore, all systems will be equipped with the same components: Ethernet cards,

Microsoft Internet Explorer ® World Wide Web browsers, mail clients and the Microsoft Office® application suite.

Technologies

The employed technologies and provided services are chosen to facilitate the achievement of the desired goals of curriculum integration with technology in a seamless environment. Because of the mix of operating systems and computer models the computing capabilities of the stations are not the same. The web server plays an important role in the integration and collaboration capabilities of the different elements of the Electronic Studio. The platform independence afforded by browser and server based applications overcomes these problems. For the applications developed for the school, many tasks are carried out by server scripts written as active server pages, where the server generates HTML based on user input and the content of server based databases http://www.microsoft.com/syspro/technet/boes/bo/iiserver/prodfact/aspover.htm).

One of the functions of the Electronic Studio is to serve as an area where completed projects can be displayed for others to learn from them. To facilitate this function in a heterogeneous computing environment Adobe Acrobat® (http://www.adobe.com/acrobat) networked printing services were installed in the system. This allows the participants to publish their work in a portable format that will retain all the characteristics of their creations.

Web databases

Web based databases are an integral part of the system since they enable the users to create a dynamic learning environment and to become active participants in the resource creation for the school. Having the learners access and interact with the databases through the browsers helps create a unified front for information, while bypassing the differences in platform and machine capabilities that characterize school environments.

Multimedia Galleries of images, movies and sounds

To support learners in the construction process, a number of resource galleries were put on line. Media galleries such as graphics, sounds and movies were placed on line and accessed through web pages. Previous work with similar groups demonstrated that the adoption of new teaching styles and the inclusion of technology in the curriculum was significantly affected by the number of on-line support structures provided to the learners (Solís, 1997b). This provides learners with a starter system for project development. Later on, individuals create their own galleries, which they share with others through their own web space.

Web Boarding

An important component of building a collaborative environment for construction is to enable users to communicate within and between teams. In this system two technologies were deployed. Basic communications are handled by e-mail, with web based e-mail directories for every member of the learning community. However, learners are also capable of exchanging ideas and documents through the use of a web boarding system that enables individuals to chat in real time, upload work in progress and post messages and follow ups (http://webboard.ora.com/). Threaded discussion groups were also set up to allow learners to exchange opinions on current events, and to respond to posted problems, allowing them to criticize each others solutions. This last approach is similar to the Guided Collaboration systems described by Guzdial et al. (1997).

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New Expectations for Technology in Teaching: Are Teachers Prepared?

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This panel will discuss a systematic review of statewide requirements and initiatives for information technology and teacher education. A comparison will be made among three states: Colorado, New Jersey and New York. For preservice teachers, the study will examine the role of technology in certification requirements: is technology explicitly mentioned? If so, is it considered a separate requirement or integrated into other requirements? How is the issue of technology in teacher education implemented in colleges of education? For inservice teachers, how do states accommodate the changing expectations of teachers' skills? Is there a systematic method for professional development or is it left to individual districts or to the teachers themselves? Finally, do statewide initiatives for teacher education reflect the new standards for students?

This review will lay the groundwork for a national or perhaps international study of the status of information technology and teacher education. The resulting information will provide a basis for SITE's development of recommendations for technology and teacher education standards and methods for achievement of these standards.

DISTANCE EDUCATION

Section Editor:
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Distance Education, a section that did not exist just two years ago, is now one of the largest sections in the Annual. There are several reasons for the rapid rise in interest. Those reasons include the Internet's increasing sophistication and ease of use, a growing number of both students and faculty who have computers and who use the Internet regularly, and a developing anxiety on the part of higher education about rising costs of traditional education. Distance education is, in fact, an "old" field, that was around for more than a 100 years before computers were even invented. But, the development of new technologies, from the Internet to video conferencing, has reinvigorated distance education. That, combined with concern over keeping the costs of higher education in check and serving populations of students who cannot come to traditional campus-based courses, makes distance education today a very active and dynamic field. That is illustrated by the papers in this section.

Several papers describe innovative projects that either demonstrate creative uses of distance education techniques to deliver instruction to teacher education students or illustrate ways of teaching students about distance education. The work of Jostein Tvedte and Svein Lysne at Stord/Haugesund College in Norway illustrates the first type of paper. They describe a sound conceptual framework for thinking about distance education for teacher education students. The paper by Weidenfeld and Leclet, at the Universite de Picardie Jules Verne in France, is another example of the first type of paper. They are creating distance education programs to teach teachers and trainers about multimedia . A third example is the paper by Steve Schlough and Suwathana Bhuripanyo at the University of Wisconsin-Stout. Their paper is about a course they taught over the Internet on task analysis while the paper by Mory, Gambill, and Browning at the University of North Carolina at Wilmington was on training and development.

Harriet Taylor's paper is an example of the second type of project paper. Her work at Louisiana State University is an interesting way of "learning by doing" in a graduate course. A very comprehensive effort to prepare college faculty to use online learning approaches was reported by Hoffman and Ritchie at San Diego State University. Their work with faculty all over California is the basis for many sage pieces of advice concerning workshops and support for faculty. The paper by Christos Bouras and his colleagues at the Computer Technology Institute in Patras, Greece, deals with an even broader concept – the support of open and distance learning environments across the European Union.

Several papers have asked questions about what constitutes "good" distance education. Barbara Mc Kenzie and her colleagues at the State University of West Georgia approached this general question by developing a list of potentially important teaching behaviors in distance education and asking experienced distance educators how important each behavior was. A similar approach was taken by Donna Everett at Morehead State University in her study of important aspects of the delivery of distance education.

Melanie Hill, also at West Georgia, took a different tack. She describes work on the support system for West Georgia's distance education program, and concludes that strong support services are critical to success. James Lehman and his colleagues at Purdue University thoughtfully discuss several models of distance education based on their extensive experience with distance education at Purdue. Still another approach was taken by John Cochenour and Carl Reynolds at the University of Wyoming as well as Randal Carlson and colleagues at Georgia Southern.. Both these papers provide a set of suggestions and sage advice is based on work in a sizable distance education program at the author's respective universities. A similar approach was taken by Pan (The College of New Jersey) in his paper. Penny Garcia (University of New Mexico) incorporates several aspects of good Internet practice in her paper on the impact of Web and Internet access in a cooperating public school.

Another type of paper describes specific concepts or frameworks for doing certain types of distance education. For example, Finder and Raleigh at the University of Wisconsin-Eau Claire, describe a framework for introducing

K-12 teachers to ways of introducing the Internet to their classrooms. Mertindale and Ahern at Texas Tech University discuss the use of concept attainment theory in the design of web-based instruction. Leclet and Weidenfeld, at the Universite de Picardie Jules Verne in France, focus on the issue of how users of distant education resources on the Internet will search for information.

Finally, there are papers that look at a specific aspect of distance education. A good example is the paper written by Ann Barron and Chet Lyskawa at the University of South Florida. They provide a quick overview of the electronic tools available for creating and managing online courses. That topic was also the focus on a paper by Abbie Brown and Lisa Hansen at Indiana University. They systematically developed an assessment procedure to evaluate several different types of electronic tools for creating and administering distance education courses over the Internet. Ruth Gannon-Cook, at the University of Houston, offers a perspective on distance education that emphasizes the role of apprenticeships and storytelling in the understanding of what distance education can be.

A fourth specialized paper, by William Lynch and Michael Corry at George Washington University is on another topic of interest to many of us – faculty recruitment, training, and compensiation for distance education. Elizabeth Kirby, at the State University of West Georgia, offers suggestions for supporting distance education teachers and students at the high school level. She based her suggestions on conclusions from a qualitative study of distance education courses for high school students that included facilitators on site and remote teachers who could be accessed via phone. Finally, the paper by Judi Harris at the University of Texas is an innovative look at web page design. Her premise is that we should carefully consider the function of a page and then design the form of the page to support that function.

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A Model for Teacher Training Assisted by Information Technology

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The problem addressed in our R&D work is: Is it possible to make a common model for education, without considering the physical location of the students? And if so, does the electronic presentation interfere with the way the curriculum should be presented?

Our R&D work is based on experience from traditional lecturing in the classroom where the teacher plays a dominating role in presenting the material to the students, as well as from experience from Open and Distant Learning (ODL) where the teacher presents the written material and gives advice during the learning process through electronic conferences, e-mail and so on. We have over the past six years worked in the European JITOL (Just In Time Open Learning), which is a project that has been terminated but continues on in the similar Norwegian project NITOL (Norwegian network for Information Technology in Open Learning). Through this projects courses have been gathered into a course pool in coorporation with other educational institutions.

In our R&D work we have tried to take the best parts from each type of teaching, and integrate them in the same learning environment for both on-campus students and distance students. We have found that it may be important, even necessary, to start a course with considerable control on the part of the teacher, and then gradually decrease the time used for lecturing. As lecturing decreases, time can be used to advise the students concerning the assignments and problems in the curriculum. This is based on the idea that we have to bring the student up to a certain level before we can start using a more student-centered problem based approach where the Internet is used as a main system for distributing the curriculum, and to support conferences, information seeking and so on.

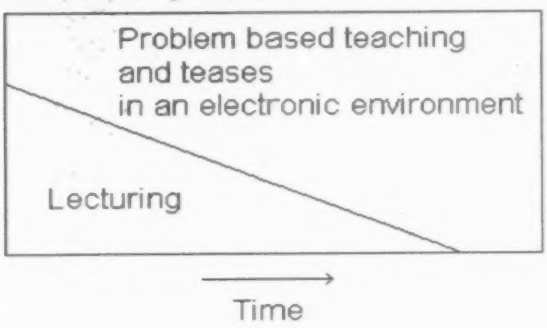

Figure1. How to organise the study.

How long should this teacher-controlled instruction and lecturing period last? This will be influenced by the level of the course. In undergraduate courses, this period should be longer than in higher level courses. This is natural because in higher level courses we can base the teaching on earlier experiences both concerning the curriculum and the way of teaching.

Initiating an Electronic Learning Environment

Gathering the students in the beginning of the course is important. The students should get an opportunity to get to know each other. This is an important factor in how the virtual classroom shall work later. We find it rather difficult getting a virtual classroom to work especially if the student do not know each other and do not have any ideas of who they are *talking* to through an electronic conference. Students can sometimes find it rather frightening to ask a question (in writing) in a virtual classroom, where they do not know who is reading the question, and also knowing that the question will be published (and read) over a long period of time. It is much easier for a student to ask a question in a physical classroom, where he or she faces a limited number of listeners, and where the teacher in every sense can *help* the student to ask the question. As we often see, teaching is a process of helping the students to ask the right questions. Very often they do not know (or can not explain) what they do not understand. The important role of the teacher is to be a catalyst in the learning process. To

achieve this in a virtual classroom, it is a great advantage that the student knows and trusts the other students that will read their questions. In regard to this we find distinct similarities in the physical and the virtual classroom.

It can be rather difficult to initiate activity in the virtual classroom if the students do not have any other relationship with the fellow students besides the communications through the virtual environment. We have seen this clearly in different courses we have run, where the students in some courses are presented only to the virtual classroom, electronic conference and so on without any advance introduction, and courses where the student are gathered in the start and can establish contacts and relationships than can continue in a virtual environment. If gathering the students at the start of the course is impossible to arrange, due to for instance long distances between students, an electronic presentation made by each student can be done in order to establish contact, and let everyone get to know who is participating in the course.

Problem-Based Learning

One very important point in having a common study for on-campus and distributed studies, is to organise the study in a more problem-based way. Instead of writing long lectures for distribution on the Internet, or trying to write down every word that you would have said in an ordinary classroom session, you define problems to be solved by the student, and in that way specify the curriculum to be learned. The teacher needs to have an overview of important literature, articles, web-sites and so on, specifically where the curriculum can be found, and therefore the role of the teacher is changed. The teacher will be an adviser for the student. This is quite a significant change. The student plays a more important role in his or her own learning process. By shifting from teaching to problem-based learning, we can use the same methods for both on-campus and distributed students. Without concern to the physical site of the student, the two types of students are able to solve the same problems, seek information in the same places, and discuss their theories in the same electronic conferences. The teacher will no longer have the role as the person who *delivers* the curriculum through lectures on the campus and through written text to the distributed students. Too often we see that the only difference between on-campus lectures and ODL is that in the classroom the teacher teaches the curriculum (mostly orally), and in distance learning he or she writes the same subject matter. Through problem-based learning we can remove this difference between teaching in the classroom and ODL by placing the problem in the centre and changing the teacher's role from being a speaker in the classroom or a writer in ODL to an adviser in a student centred problem based learning environment independent of the students physical location.

Shift in the Role of the Teacher

The integration of on-campus and distributed studies, and the focus on problem based learning has very clearly shifted the focus in the courses and can in short be summarised as a shift from teaching to learning. This has also changed the role of the teacher. The teachers' main functions in the learning process are:

1. The teaching in the classroom will focus the main topics in the curriculum.
2. Teaching in the electronic virtual classroom can include the organisation of the electronic classroom, presentation and organisation of the curriculum, literature, articles, web-sites, organisation of information bases, electronic conferences and so on. It entails also being a kind of catalyst where the teacher tries to keep the students involved and interested in the curriculum and the learning process in the electronic classroom.
3. A very important part for the teacher is in the definition of problems related to the curriculum. In problem based learning a main issue is to define the contents of the curriculum.
4. The teacher also has to be an adviser in the learning process. When the students concentrates on problems, the teacher will have to be a resource in the learning process, and an adviser in the problem definition and solving process. In order to fulfil this students demands, the teacher will have to have a overview of different methods, algorithms, strategies and so on, to be able to advise students in many student defined ways to solve a problem.

Shift in the Role of the Student

The most obvious change in the work of the student is that it has shifted from a situation where the curriculum is presented in the classroom, to a situation were curriculum has to be learned out of the need to solve a problem. This is a situation where the students are much more responsible for their learning process. They can get assistance from the teacher which is related to the specific problems in the study. This is an important part because if the time used to lecture is reduced, the students will instead get more contact with the teacher through the problem solving process. The limited contact with the teacher in the classroom will also force the student to use electronic tools to communicate and seek information. This way other students on the course, information bases, search engines and other resources on the Internet will play a major role in solving problems.

The main topics in the students' work will be:

1. Introduction to the curriculum through teaching, either in the classroom or electronically on the Internet.
2. Introduction to problems which state the most important parts of the curriculum to be learned.
3. Problem solving which includes continuously seeking

of information, assistance from fellow students and teacher, and feedback from the teacher.

4. Feedback on the assignments.

Feedback is important both for the student and the teacher in order to check that only relevant information and curriculum are part of the study. The assignments can be optional and/or obligatory for the student to complete in order to take the finishing exam. Assignments can also be a part of the student evaluation.

A Case Study

A questionnaire was distributed to a group of 35 students in a introductory course on ICT in teacher training. In this group the use of traditional lectures had been reduced to approximately 50 %, and the use of problem based methods was accordingly increased.

Preliminary findings

The students disliked the reduction in time spent on lecturing. They seem to feel more comfortable in a traditional learning environment, together with their teacher.

The students are positive in their comments to problem based learning methods. But almost all the students want the teachers to spend more time together with them in the classroom or in the lab! Not even very frequent use of e-mail or news conferences can replace the presence of a teacher.

The students present mainly formal, well formulated questions on the news conference. We seldom see spontaneous, informal questions. The news conference is a too formal channel of communication, perhaps because it appears so official. *Many to many-communication* is perhaps the most complicated and challenging area to transfer from the live classroom to a virtual learning environment.

More than 50 % of the students in the group use net search, (search engines like Alta Vista and Lycos), in order to solve assignments in their studies. The Internet and news conferences as tools for seeking information seem to be functional and frequently used tools. But these tools appear to be less functional for asking questions and for discussions of ideas. E-mail may be a better tool for *private* and not so precise formulations.

Summary

By defining the virtual classroom as a combination of the use of Internet, news conferences and e-mail, we find some main points:

- The presentation and seeking of information can in many situations be replaced by electronic tools.
- The interaction seems to be the most difficult part to integrate in a virtual environment by using electronic tools.
- The use of e-mail seems to function best and especially in the one-to-one communication between teacher and student.
- Simple, updated access to information is perhaps even better implemented in the virtual learning environment than in the traditional.

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Open and Distant Training to Multimedia for Trainers and Teachers

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What are the competencies and knowledge needed by teachers and trainers in order to use efficiently the *new technologies* of information? This paper aims at giving some answers to this question and describes a distance training action which enables to acquire the desired topics. The *theoretical* knowledge which is needed is first briefly described. Another essential characteristic of this action, the acquisition of the true capacity to realise a real project is then discussed. The second part of the talk is related to the design of a modular, open, accessible from a distance, training action which uses both specific multimedia training supports and conduct patterns based on the telecommunication numerical networks. The design of the multimedia supports specifically developed for this action is also commented.

This action, which registers itself in a larger scope of distant training to multimedia [11] aims at giving to non computer scientists, technical bases allowing them to, either create or round off, training interactive supports. Of course, at these two levels of targeted tasks, there are very different technical uses, and one of the essential characteristics of this training is its modular aspect: the contents are sliced into elementary units called " modules" accessible independently.

Another essential characteristic of this action relies on the acquisition of the true capacity to realise a real project. Thus the teachers who take part in this training are not just inclined to acquire a new diploma (related to the acquisition of a full set of multimedia knowledge offered to them), but rather wish to improve their competencies as far as conception and realisation of educational tools are concerned.

The global target is therefore to conceive a modular training, open, accessible from a distance, for such activities as conception, conduct and realisation of multimedia projects intended for training. This communication tends to present the plan of action which is now under development. This plan uses both the multimedia training supports and conduct patterns based on the telecommunication networks.

The peculiarity of this training is that it introduces a "double entrance" :

- The first one corresponds to a classical approach through "themes" : the knowledge is accessible through a thematic organisation which is explained. However this knowledge is gathered into modules, it gives it a flexibility when being brought into play and allows to adapt the progression to the inter-individual variations.
- The second one corresponds to a complementary approach through means of "jobs". Thus, the way to explore the information network built this way constitutes a professional entry. It is the description of the multimedia training products conceiver/director 's "job" which supports a contextual approach the content: one can, starting from a professional practice, have access to the necessary knowledge for its achievement.

Multimedia competencies and the development of training supports.

In order to acquire knowledge with the purpose of the acquisition of multimedia competencies various subjects have to be taught. The following subjects are then necessary :

Technical topics related to the multimedia domain

The following are examples of technical topics that are useful for designing educational products. In our opinion, project designers have, at least, to be aware of the current stage of advanced technology in the following domains. The courses related to these technical topics will provide the amount of information needed to communicate with other (technical) partners in the project

- ***Computer graphics and computer images***: generalities about computer pictures (modes, formats, compressions,...), picture transformation with 2D and 3D algorithms, technics of realistic transmission systems

and of picture analysis and processing.

- ***Networks***: network technology and the various transmission modes are studied. The purpose is to present the technical features that may be necessary for explaining some behaviours of information transmission on the web. One key point is to understand the constraints on large files (images, video, high resolution sound) transmissions.
- ***Interfaces*** : software ergonomics, design of friendly user interfaces, the use of agents and basic knowledge of Java language.
- ***Knowledge basis*** : type of data, organisation of data sets connected to the objectives, representation of knowledge, the acquisition of knowledge, multimedia and knowledge representation.
- ***Documentation systems***: the electronic management of documents, the various way for indexing documents and the associated methods of information retrieval. The navigation process and the use of hypertext and hypermedia.

Methodological contents related to projects analysis and management

The next topics are directly related to the practice of project design and management.

- ***Project management methods and tools :***
  Significant multimedia developments are always undertaken by a team of people having various competencies (technical, artistic, pedagogical, content expertise, marketing,...), and also various behaviours and habits. Project management methods are needed in order to take this heterogeneity into account. Practical management tools will give a concrete meaning to these methods.
- ***Needs analysis :***
  It is related to information extraction from experts and trainers and evaluation of benefits deriving from the use of new technologies. As an example:
- ***Extension of training to a larger number of participants :***
  - Greater availability of training
  - Improved costs/benefits relationship
  - Improved transfer of skills
  - Individualised instruction
  - Possibility of self-paced learning
  - Reduction of individual learning time
- ***Multimedia design methods :***
  Adaptation of some method used for analysis in computer science and software applications may be useful for the design of educational products. Among these methods, object oriented and knowledge description approaches are prominent,

Computers in education

The use of computers for education and training did not start with multimedia or the internet. A lot of developments have been made in the last thirty years and it seems important to have a good perspective about their successes and failures. A survey of CBT, simulations and microworlds will hence be useful for designing new generation multimedia educational products.

Tool handling

Practical knowledge such as picture scanning, sound or video digitalisation, multimedia script organisation by means of a simple authoring tools, etc... may be useful for project designers, even if other people are in charge of realisation. This type of knowledge is, in itself, the least complex to teach. However, in the case of distant teaching, it becomes very delicate to put up. On the other hand, this knowledge, taken as a whole, takes quite a long time to acquire. Moreover, all of it is not useful and strongly depends on the professional project to be realised. In fact, a training project consists in the building of a system allowing the web surfing through this knowledge in regard of the project's needs.

As a support of the training action, we are in the process of building a large hypermedia system including all the topics mentioned before which will be used for distance training. This work will now be described.

Interactive multimedia supports for distance training

The training action discussed here is part of a more general distance training action, dedicated to general multimedia knowledge and competencies. This work relies on the design of interactive supports that can be used in several ways. The *paths* that will be explored by trainers and teachers is determined by their own needs. The overall project is briefly summarised in this section.

Design of interactive supports related to multimedia topics

In order to put into place the distant training plan, various stages have been considered:

- At first, the writing of two books, one bearing the title "Technical basis for the multimedia" [10] and the other one "The management of multimedia projects" [1], have been made as paper class support.
- Secondly, creating hypermedia books is now a major priority. Compared to the paper version, these hypermedia books have two major plus :
  - ***Indexing***: it is not difficult to provide a user with several types of indexes for multimedia material. Multiple ways of indexing enables several browsing approaches, according to the various « thematic » interests ([2], [8]).
  - A ***complementary browsing method*** is provided by an additional *linguistic* work on the index. A

collaborative definition of synonyms, antonyms, proximities, etc enables the building of a thesaurus. This thesaurus enables us, in return, to create links quite automatically [3]. These links will, for instance, enable users to explore the various meanings of a same technical word according to the viewpoints developed by the authors. The interest of this approach is widely linked to the cultural heterogeneity of the group of authors [7]. Some of them belong to academic staff and in that case their differences rely mostly on disciplinary aspects. Some of the other authors are professionals in an area of technology and they insists on more practical features.

- At last, the use of interactive simulations ([4], [5], [6]). For some of the previous activities, it is possible to associate an interaction, achieved through a computerised program, to the part of the hypermedia which will illustrate the concept or idea under study. We shall call such a program an *interactive simulation.* As an example, interactive simulations may be used in order to explain how information is conveyed on a network, how a communication process works, etc. Simulations will play the same role as a lab activity in the teaching of science. However interactive simulations rely on a mathematical or physical model of the domain. It is well known that human activities are not built on this model. In order to consider that point training material will include the next feature.

Multimedia cases describing the professional practices.

In order to create this class based on the experiences of the designer, we have described [1] the different stages of product making for different types of interactive support. For educational purposes the supports taken into consideration are : computer assisted presentations, computer based training, simulations, documentary systems, and cultural and encyclopaedic multimedia systems. The stages taken into consideration are, as far as they are concerned: the analysis of needs, the expression of the objectives, the determining of interactions, the determining of interface, the programming of interactions, the analysis of the answer, etc...

Thus, to write these monographs, the authors will have marks: the themes summarising the theoretical contents. The former slicing is obviously inspired by the management conditions of a multimedia project. In the same way, the technical themes that will be used to describe the activity will be selected.

Organisation of the distant training

An initial interview (with the possible help of a screening system) will allow the elaboration for each person of an individual degree course. This elaboration will take into account the acquisitions and the objectives of each one. In the end, it comes to the global suggestion of modules and/or to the suggestion of supports to be studied, as well as an evolution within this study.

Moreover, for each of the modules taken into consideration, there will be an allocation of individual tutoring for two hours. This tutoring will allow:

- The correction of the applications and activities offered in this module.
- Regular communication, through e-mail, between the tutor and the learner. This e-mail (with *mail* and *talk* facilities relies upon the installation of an access server accessible from the university servers)

Besides the individualised help given to the learners, this e-mail will make the updating of so-constituted knowledge easier. Therefore, the message exchange format will include such elements as :

- The information, by the learner, about the reference of the chapter(s) regarding his question.
- The information, by the tutor, of the general interest "level" of his answer (circumstances or deepening compared to the existing contents).

This information will not only allow the collection of quantitative data, but also, after the validation of the project leader, the putting into place of hypertext links so that the next group of users will have access to this correspondence.

Conclusion

The action described here is still in progress and the first objective is to set up the distance learning course. During the next academic year availability of learning material will enable us to start an experience with a significant amount (over 30 %) of distance interaction. During the 1998-1999 academic year the final version will be completed, with some experimental and evaluation features.

Another direction is to adapt the described method to other contents. Business managers make intensive use of information and they need to acquire information retrieval abilities [9]. We are actually looking for an adaptation of the system described here in order to fulfil these needs.

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The Development and Evaluation of the Internet Delivery of the Course "Task Analysis"

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The course, Task Analysis, is one of the required courses in the Bachelor of Science degree in Vocational Education, the specialization in Training and Human Resource Development, as well as the Master of Science degree in Training and Development at the University of Wisconsin-Stout. The course is offered by the Communication, Education, and Training Department.

Normally, the course is delivered by the instructor to students in the form of lectures in a traditional classroom. In the summer of 1997, the method of delivery was changed from traditional learning to asynchronous learning, using the Internet. This was a means of delivering the course content to meet the needs of a cohort of students who were teachers at the Milwaukee Area Technical College, and enrolled in the Vocational Education undergraduate degree at the University of Wisconsin-Stout. Milwaukee is approximately 265 miles from the UW-Stout campus. Many of the courses for the program had been delivered to the students face-to-face on weekends in Milwaukee, but it was felt that they needed more flexibility to complete the program. The Internet is considered the fastest growing educational phenomenon in the history of the world (Dryli & Kinnaman, 1995). It allows students to learn anywhere, at anytime, as well as to access content at their own pace. Therefore, a WWW-based instruction program on the subject of Task Analysis was developed using the authoring software, *ToolBook II Instructor,* in order to deliver the content to students enrolled in the Task Analysis course in the summer 1997. In addition to content delivered via the WWW, additional resources were placed on a *Lotus Notes Domino* server. The course was offered in two separate sections. The first section consisted of UW-Stout undergraduate students who were in the Vocational Education Program and were employed as teachers at the Milwaukee Area Technical College. Students who were pursuing undergraduate and graduate degrees at the University of Wisconsin-Stout were included in the second section.

Literature Review

The literature review for this study (Bhuripanyo, 1997) started out by looking at computer-based training The section reviewed tracking students responses (Campbell, 1993), students controlling of sequencing (Kearsly, 1983), and the differences between classroom instruction and computer-based learning (Steinberg, 1991).

The next section of the literature review dealt with authoring systems. Yeager (1993) addressed the four areas that an authoring system should handle; presenting information, judging answers, branching, and managing instruction. Hefner (1996) discussed the features of an authoring system and reviewed Authorware, IconAuthor, CBT Express and ToolBook Instructor II. The rest of this section discussed ToolBook Instructor II (Hall, 1997) as it provided a solution to convert authored content to HTML so that it could be accessed over the WWW.

The last section of the literature review examined the use of the WWW in education. Relan and Gillani (1997) addressed different methods in designing instructional strategies using the WWW. Driscoll (1997) provided an in-depth discussion of web-based training and compared web computer-based training, web-based employee performance support, asynchronous virtual classroom, and synchronous virtual classroom. Hall (1997) compared the advantages and disadvantages of web based instruction.

The review of 1996 and 1997 studies by Chamlongsupalak laid the foundation for the research design.

Methodology

The research study was designed to assess the effectiveness of a Web-based instruction program in the delivery of task analysis content. The program was partially developed by using *Asymetrix ToolBook II Instructor* software. In evaluating the program, all students enrolled in the Task Analysis class were asked to complete the evaluation forms. The form was used as a research instrument to evaluate the effectiveness of the Web-based instruction program.

The program was presented and delivered on the Internet during a period of eight weeks in the summer of 1997. To inform participants about this research study, the

researcher sent out cover letters along with the evaluation forms on July 15, 1997. Each participant was asked to fill out the evaluation form and return it in the provided envelope by the 30th of July 1997. A total 13 evaluation forms were sent back to the researcher. In order to increase the response rate, follow-up letters and evaluation forms were mailed out to the participants who did not complete the forms in the first mailing timeline. The second timeline allowed participants until the 10th of August 1997 to respond. Nine evaluation forms were completed and returned to the researcher. There were 22 (57.89%) returned evaluation forms from both mailings.

Findings

The respondents were asked to rate each of the following statements a 5 point Likert scale with a point range the included; 5 (strongly agree), 4 (agree), 3(no opinion), 2(disagree), and 1(strongly disagree). The mean scores for each statement follow.

Table 1.

Statement	Mean Score
Objectives of the program were clearly stated.	3.68
Content organized in appropriate sequence.	4.00
Content was relevant.	3.86
Content was understandable.	3.23
Content was knowledgeable.	3.55
Content was clear.	2.91
Content was accurate.	3.64
Content covers all essential information (both theory and practice).	3.36
Content was useful for the practical session.	3.05
Content was free of spelling and grammatical errors.	4.00
Content contained effective illustrations.	3.64
Attractive title screen /design.	4.05
Legible and attractive text.	4.00
Detailed and step-by-step instruction.	3.09
Understandable and logical command.	2.95
Attractive colors/design.	3.91
Effective use of graphics/colors.	3.95
Effective function key.	2.90
Helpful main menu screen/user's guide.	3.14
Effective navigator.	2.82
Easily controlled the sequence of the program.	2.95
Met student's needs.	3.09
Met students expectations.	2.86
Appropriate instructional format of the course	2.95

There were no statements that received a below average rating.

When the respondents were asked, If you could take this course again, would you prefer to take it: (A) In the classroom (B) Via the Internet. Seventy-seven percent responded that they would prefer in the classroom and twenty-two percent responded via the Internet.

In addition to the data gathered through this study, graduate students enrolled in the course performed an analysis of the WWW delivery system. A summary of their discussion follows categorized under the headings: strengths of the course, weaknesses of the course, and recommendations.

Strengths of the Delivery from Students

- The delivery provided convenience to the learners both in terms of freedom of time and freedom of space.
- It promoted individual learning yet allowed for group learning activities.
- It allowed learners to process course material at their own speed.
- Opportunity to read classmates' opinions through postings to the Lotus Notes Learning Space CourseRoom. Each posting brought new insight because of the diversity of the students.
- The clarity of the on-line content provided exactly what you needed to know. In classroom experiences the professor often provides more information than what is needed and the student is left wondering what is important and what isn't.
- Using the telephone to discuss projects with the instructor allowed for a sense of connection.

Weaknesses of the Delivery from Students

- Required the learner to be self-disciplined
- The delivery was not appropriate for all learning styles.
- Despite on-line discussion groups and contact from the instructor some students who did not work in pairs or groups felt isolated and the delivery has the potential to be impersonal.
- Although the WWW content portion of the course that was evaluated in the study was considered relatively easy to use, the Lotus Notes Learning Space section was considered to be confusing to some users.

Student Recommendations

- Make sure that all participants understand the nature of the course and it's limitations.
- Participants should be encouraged or required to work in small groups.
- Improvements in the Learning Space application suite.
- More in-depth orientation to the course and the software.
- Provide a print version of instruction to software use.
- Set up a chat room so students can dialog in real time
- Have students find an Internet site relating to the course and report back to the class on it.
- At the end of the course have a face-to-face meeting of the students.
- Have a mid-term meeting or teleconference.

Summary and Recommendations

Based on this study and other evaluations of the course, it was found that this is a viable way to deliver teacher education instruction to students at remote locations. However, there are some concerns in making Internet delivery a viable alternative to classroom delivery. To better understand the study, it is important to look at the students who took the course and served as participants in the study.

The vast majority of the students in this course were employed as full time teachers in the Wisconsin Technical College System (WTCS) and had associate degrees in a technical area and were completing an undergraduate degree to meet WTCS teaching certification requirements. They were not given other alternatives in taking this course. They were asked some questions regarding the assumptions of this study before it was decided to offer the course in this format. All the students indicated that they had sufficient knowledge and skills related to the use of computers and that they had experience using the Internet. This did not prove to be the case. There were some miscommunications on the availability of adequate computers for them to use at their site and misunderstandings about the level of support available. These issues caused the students some problems as they were getting started. Based on these considerations, the findings of the study, and other input, the following conclusions can be drawn and recommendations made regarding the Internet delivery of the course Task Analysis.

Internet delivery of this course and others shows much potential. It is important that students know the nature of the course before enrolling. For some students, it would be possible to enroll and start at any place and anytime if they have adequate computer skills, can work in isolation, deal with ambiguous situations, and are self-motivated. Students were provided with a checklist, relating to these issues for self-evaluation before beginning the course. Even though students responded positively to this list, many expressed a desire for more support as they proceeded through the course. There is a balancing act in trying to provide as much support to the students as possible and yet allowing them freedom of completing the course at their own pace. It appears that a face-to-face orientation session is important to most learners. There was a three-hour orientation session provided to all students enrolled in the Milwaukee cohort, although one hour of this time was spent in registration and other procedural items. There was also an optional orientation session available to students enrolled through the on campus section.

The first recommendation would be that the course be offered 4 times a year with a one day orientation session. This orientation would be offered at different sites throughout the State of Wisconsin on a rotating basis. The first half of the orientation would familiarize the students with the delivery and the content of the course. During this session the students would be allowed to split into project teams if they wanted to work together. If they chose to work alone, they would be paired up with a "buddy" so they would have someone to contact in addition to the instructor if they had concerns as they progressed through the course. The second part of the orientation would deal with the computer and Internet skills. The students would be provided with hands-on training in using he existing on-line instructional packages. This would insure that they could log on and maneuver through the program. They would also be provided with some background on the Internet and the World Wide Web as some frustrations were caused by not understanding how Internet browsers function and are configured. This computer training also allows for the introduction of more advanced WWW features that allow for better connectivity and submission of projects. A printed guide to the software should be developed as those students who had the most problems with the software were the least comfortable using on-line help. In addition to being partnered with someone in the class for support, each student should have a technical mentor to help them with technology-related problems and a content mentor to provide them with subject-matter related support.

There is a need to include more information in the content section. This would make the course less dependent on print resources. The interface should be evaluated to see if it is as effective as it could be. Although, all complaints on interface design centered on *the Lotus Notes Learning Space* portion of the course, there may be ways to better integrate the content section of the course with the *CourseRoom* and the quizzes. It should be noted that this course was offered shortly after *Lotus Notes* became WWW enabled and there should be improvements as new versions are released. It would also be possible to use the *Notes* client software but that was avoided to make the course easily available at more locations.

The idea of mid-term teleconference and end of the course videoconference should be explored. One disadvantage to this is that it would take away some of the flexibility that was offered to the students, as they would all have to complete the course at the same time.

The course should also be marketed to potential students who are more computer proficient. This market would not require the orientation and would allow for more experimentation with a more open-entry open-exit delivery system.

The potential for the Internet delivery of courses should continue to grow as more people have Internet connections and become more proficient in the use of the Internet. It should provide an excellent avenue to provide courses to educators in the field, but probably has less potential for those aspiring to become teachers.

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Instruction on the Web: The Online Student's Perspective

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The purpose of this study was to examine the experiences of two university graduate students while taking an on-line course over the Web, in order to identify issues of design, implementation, and motivation from a users' perspective. With the rapid growth and increasing accessibility of the Internet, numerous universities are making on-line telecourses available to students (Barnard, 1997; Kearsley, Lynch, & Wizer, 1995; Stahlke & Nyce, 1996). While researchers are beginning to examine the design and implementation aspects of on-line instruction (Berge, 1997; Couples & Luke, 1996; Eggers & McGonigle, 1996; Pisik, 1997; Trentin, 1997), few studies have documented the experience from an online student's perspective.

Data collection included descriptions of course content, page design and presentation, assignments and tests, communication techniques, schedule of events, and student/student and instructor/student interactions. Experiences were documented through the use of questionnaires, interview data, and student's annotated experiences during the course semester. Issues of course design and delivery, communication restraints, logistical uncertainties, motivational needs of learners, and technical problems will be discussed.

Description of the Course

The on-line course was a graduate class on the methods and techniques of training and development. The course was part of a funded university project in eastern North Carolina in which twenty-five existing university courses would be moved to the Web. The course was the first of its kind offered by the Training and Development program of the university using the Internet as the medium of delivery. The course contributed to the program's philosophy to demonstrate alternative delivery modes while providing students with the opportunity to experience such methods as designer/developer and learner.

Structure of the On-Line Course

Course information was provided through Internet connection via the student's computer. The course incorporated regular interactions between the instructor and students and between students. Major course requirements, expectations, schedule, assignments, and other information were organized through designed web links to individual parts of the course. No on-campus student attendance was required. Communications between student and instructor could occur using e-mail, the discussion group, telephone, fax, and surface mail. Students were also welcome to schedule conferences on campus or via the Internet during the semester.

The basic core of the instruction was organized into ten lessons as listed in an on-line course syllabus. Each Internet lesson included common elements of an introductory narrative, assigned readings from required textbooks, supplementary resources, key point/concept explanations and discussion, applications and examples to support key points, self-evaluations, discussion questions, and assignment/evaluation. Each of the ten lessons had its own web page. Most lesson pages consisted of text and diagrams to illustrate the main points. One lesson included presentation slides. Students printed out each lesson in order to read and stu[illegible]b page lesson notes as a supplement to textb[illegible]adings. Each lesson ranged from approximately 13 to 38 printed pages in length. The purpose of the course was to prepare training and development professionals. By the end of the course, students were to recognize that effective training is based on an understanding of how people learn and differences in types of learning in order to make objective decisions as instructional designers and deliverers of training to result in performance improvement.

Course Requirements

Students were given detailed explanations of several main course requirements. Table 1 presents an abbreviated overview of these requirements.

Assignments and other required course work were submitted to the instructor through a student file. The student file was password protected so that only that student and the instructor could access the file. As students completed an assignment, they moved it to the student file and notified the instructor via an e-mail message. The instructor evaluated each assignment within approximately

three days and placed it back into the student's file with a grade and evaluation comments. Students were responsible for completing the lessons in order and according to specified and assigned due dates.

Table 1.
Course Requirements.

Prepare a synthesis paper and describe relevant applications.
Prepare a background paper/executive summary and lead a class discussion.
Prepare three detailed session and lesson plans.
Demonstrate effective group instruction through a videotaped training session.
Use an assessment/evaluation instrument to gather data and analyze.
Complete a series of concept/principle quizzes.

Communications and Help

In order to allow group work and class discussion of topics and issues throughout the course, learners were instructed to follow a sequential progression through modules according to a common calendar. Discussions were managed with the Internet software tool, *NetForum*. Communication was open to all students enrolled in the course, secured by individual student entrance passwords. Each of the lessons required students to give initial responses to two discussion questions of the students' choice from a given list. Students could answer additional questions and respond to other students' answers.

"Extended class discussion" was facilitated for students to ask additional questions about the lesson or to make comments about their individual learning experiences related to a given topic. Any information placed on *NetForum* could be read by all students and the instructor. If students wished to communicate only with certain individuals in the class, they were directed to use individual e-mail addresses provided by a link from the home page.

In terms of technical help, students were to review hardware requirements and Internet procedures that were developed by the university. Special links were provided for technical assistance needs. Course information and assistance was provided through the instructor's e-mail.

Schedule

Students were presented with a set of "ideal" completion dates for beginning each lesson. Students were allowed to complete assignments and activities earlier if they chose, although initially only three lessons were on-line, with subsequent lessons added each week as the semester progressed. Table 2 contains the basic course schedule.

Students were advised that the tenth of December was the last date for completing and submitting materials. The instructor forewarned that "extensions for completing course requirements beyond the ending date are seldom granted and only for unanticipated circumstances beyond the control of the student."

Table 2.
Course Schedule.

Date	Lesson/Assignment
8/20	1
8/27	2
9/3	3
9/10	4 (Quiz 1)
9/17	(Req. 1 due)
9/24	5
10/1	6
10/8	(Req. 2 due)
10/15	7 (Quiz 2)
10/22	Student-led discussions
10/29	Student-led discussions
11/5	(Req. 3 due)
11/12	8
11/19	9
11/26	(Req. 4 due)
12/3	10 (Req. 5 due) (Quiz 3)

Evaluation

Each requirement was evaluated by the instructor based upon the criteria for individual assignments. Each requirement received a point total and grade; however, only the point total was recorded by the instructor. Grades on each requirement only reflected the relative position of the student in relationship to other students in the class based upon total performance on the particular requirement. Points were accumulated during the semester to determine the students' final point total for all activities. The total at the end of the semester was analyzed based on the percentage of total points possible and the range and frequency of scores of all students.

The listed set of percentage points for each requirement is shown in the table below.

Table 3.
Evaluation.

Description	Percentage
Synthesis Paper	20%
Strategy/Method Paper & Discussion	20%
3 Lesson Plans	30%
Videotaped Training Session	10%
Assessment/Evaluation report	5%
Concept quizzes	15%

In addition to the total percentages, the quality of class participation beyond the completion of the identified requirements could influence the students' final grade by plus (+) or minus (-) 5 percent.

Student Experiences

Subjects

The two students who participated in this study were graduate students working toward doctoral degrees in instructional technology at the same university. Both students were familiar with the use of computers and the Internet. Both students were taking the course from a city approximately 180 miles from the university campus using IBM-compatible computers. The two students both held full-time jobs in the same city, teaching courses involving the uses and applications of technology to preservice teacher education students and providing technical support in computer hardware and software. Both students had to commute between their jobs, homes, and to other classes at the university offering the on-line course.

One student commented near the end of the semester about how a course such as this should be developed specifically for non-traditional students, reflecting upon how this on-line version of the course was or should be different from the version taught in the classroom. This student had a student colleague who was taking the regular in-class version of the same course during the current semester. This traditional student related that even the in-class version of the course required a great deal of effort in order to keep up with the amount of required readings and outside assignments. The on-line student felt that anyone taking a course from a distance would likely be someone in a situation that made it difficult to travel to the university campus to meet in a classroom every week. Many of these students would not be able to attend the university as a full-time student due to a variety of constraints such as family, work, and relocation or commuting costs. This student raised the question as to whether an on-line course such as this should contain the same workload as a course that met face-to-face in a classroom each week, suggesting that the course should build in less workload to compensate for the extra time involved in students' managing their own instructional time and being totally responsible for the pace and synthesis of the presented topics.

On-Line Communications

When asked about the discussion groups that occurred on-line using *NetForum*, both students agreed that discussion among students was beneficial. Both students answered the required minimum two questions and participated in comments about other students' answers. At one point during the semester, a student at another site had a continued debate with one of the subjects concerning a topic. All students could read all other student responses. Positive aspects of this type of discussion was identified by the two subjects as (1) being able to read other students' answers and comments and (2) having time to reflect upon what was being said before reacting or responding. Further, (3) posting of answers and comments provided a record that allowed for more open pacing and review of topics. Students could return to discussion items at any time to review previous discussions and reflect further. Students also were allowed to read other students' research papers as they were entered on-line by the instructor and became part of the content of the course.

The downside of using discussion groups via *NetForum* was that it did not provide real time communication. This took away any "normal" spontaneity that having face-to-face discussions would allow, adding to a feeling of separation in time and a lack of visual contact. One subject remarked that he felt that there was an artificial politeness in the written interactions of students. Students' being overly polite or diplomatic, combined with the delay in communicating via the electronic written word, resulted in a loss of typical class dynamics including immediate emotional responses on various discussion topics. There was no way to react to a comment as one would do if one placed in a regular classroom with other students present and with real time communication.

The students did comment that in general the communication with the instructor was good, predominantly utilizing e-mail communications and telephone calls. The instructor provided an excellent turnaround rate of responses to students' questions and concerns. Of course, even with such a good response time, the logistics of communication did not allow immediate turnaround, which meant that students would have a lag time delay before getting answers or help to their questions. One student commented that he did get to meet the instructor in person on campus about three weeks before the semester ended. This meeting seemed to make the instructor more personable to that student.

Motivation and Self-Discipline

A major problem that seemed to effect all students taking the course was in individual pacing and a continual effort to keep up with the schedule. Initially students remained on-track with the "ideal" completion dates scheduled for requirements. However, as early as late September, both students began to find the multiple tasks required by the course to be daunting. One student said that in order to discipline himself, he would formally sit down at the same scheduled time of the class each week, even though he would not be required to participate on-line at a given time. The other student divided his time between sometimes meeting with the other student at the class time and completing on-line work from home. After the completion of the first paper (requirement 1), both students began to get progressively more behind.

By the end of November, all students in the course appeared to be several weeks behind schedule. One student was very stressed-out by the fact that there were only two weeks left in the semester, yet the students in the class were only "halfway through" the assignments and requirements.

While the instructor was cognizant of the problem and would send students reminders about the remaining requirements and time constraints, the instructor did remain firm to the amount required and the original timeline. The two subjects were forced to scramble during these last two weeks to complete all the requirements before the December tenth deadline. This period also involved each student's making a videotape of himself or herself teaching a lesson. These tapes were then sent to the instructor via surface mail. Viewing the videotape was the only opportunity the students had to allow the instructor to gain a visual impression of their presentation skills.

One student thought that the most difficult part of keeping up with the course requirements lied in the fact that all the information for the course was in the form of text and graphics that had to be read and studied individually by each student. In a typical classroom setting, instruction can be varied to include presentations by the instructor, vocal discussions between students, visual cues and stimuli to vary the instructional presentation pace and gain attention to more important aspects of the topics, and the dynamics of real time delivery. The fact that these on-line students had to read lengthy assignments in the textbook, at other websites, and then print and read an thirteen to thirty-eight page set of review and summary notes and submit discussion questions on each lesson required an inordinate amount of time. This was on top of writing research papers and other more "traditional" assignments of a graduate course. The time spent reading and synthesizing these different sources of information vastly out-shadowed the amount of time that would be spent if the instructor was able to present and summarize the information in a regular classroom setting. When the instructional delivery was combined with the other assignments of responding to the questions and other students' responses, writing research papers, making a videotape of one's teaching, writing lesson plans, and taking quizzes, the students felt overloaded and overwhelmed.

One student in particular felt that his learning style was such that he needed more visual and auditory stimuli, rather than just "read, read, read." This student missed the dynamic interaction of being in front of the instructor and with other students. Even the informal discussions that naturally occur outside of class among students was unavailable due to the more "formal" communication of writing over e-mail and in *NetForum* discussions.

The quizzes that the students were required to complete were e-mailed to them. Each student was on an honor-system trust to complete the exam in one hour without using any notes or other resources. When the test was completed, the students would return the quizzes to the instructor as an attachment to e-mail. One student felt that because there was the problem of taking the exam under such a trust, one should not do "too well" on the exam or the instructor might assume that that student had used notes or had taken longer than the allotted time frame to answer the questions (i.e., cheated). Thus students felt that doing well on the exam would become suspect due to the circumstances of the administration of the test This created unnecessary test performance anxiety.

Technical Problems

Given that this was the first administration of such an on-line course at the university, there was great potential for problems to occur. At least twice while the two subjects were on-line, the university's server went down. This occurred while the students were entering their responses to the *NetForum* discussion questions. Students then lost all the information that they had entered and had to begin again after the server was back up. The effect was multiplied when considering the number of total students on-line and the multiple comments and interactions that were lost as well. Presumably one's initial responses and comments to another's answer would lose intellectual spontaneity and focus if at first lost and then subsequently re-thought.

Conclusions

Results of this study indicate ways designers designing a web course, instructors teaching a web-based course, and students taking a course online can employ instructional strategies to insure the greatest probability of success. The participation in a web-delivered university course was the first experience in taking a course on-line for the two subjects of the study. From their resulting experiences, the following recommendations can be made for designers of web-instruction, consistent with current research in web-design considerations:

1. Provide a detailed schedule timeline, but provide external cues and imposed deadlines to help students stay on-track.
2. Obtain data and evaluate student reactions to the course throughout the semester to gain insight into the amount of load a student must handle at any given time. Instructors should use such data to revise and adjust course load and simultaneous assignments and readings as necessary to maximize student success.
3. Provide adequate technical support for the instructor and students. Any down time during such a course has major implications for the students and instructor and will influence the outcome of the course.
4. Provide a variety of presentation formats. Include a variety of media such as video, graphics, sound, and other cues to gain and maintain student attention and continuing motivation. Provide visual impressions of the instructor and other students if possible.

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Distance Education By Distance Education: Putting Theory to Practice in a Graduate Educational Telecommunications Course

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Graduate students in a telecommunications in education class participated in a collaborative project in which they implemented and practiced the curricular models that they studied during the course. The students used distance education to support learning about the field of distance education. They used the Web and other media for background information and visited distance education centers. To provide in-depth insights on the topic, they participated in e-mail exchanges with on-line experts, each representing a different model of distance education. The students created a unique Web site which contains not only the information gathered from the experts but links to Web pages that are good general resources on the topic of distance education.

This experience allowed the educators to become immersed in a study as a group and to develop their own models of collaborative learning supported by telecommunications. Many of the educators themselves had directed their students in such activities, but rarely had they participated in such a project. The project confirmed for the educators the value of such shared experiences and the richness and depth of learning that can occur. They also witnessed the motivational value of a real project with a real audience and the complexities of working as a team. The project clearly illustrated to them the value of distance education both as a vehicle for education and as a field of study.

Related Research

As computers and communications networks have become more common in K-12 schools, a great deal of research has been done on uses and effectiveness of electronic discussions within educational settings. From a teacher education perspective, these often focus on two populations, pre-service teachers practicing in the field or in-service teachers who are geographically distant.

Numerous studies (Hoover, 1994; O'Neill & Coe, 1996; Russett, 1995) have illustrated the value of e-mail based communications involving pre-service teachers. The models include journal writing, mentoring on decision making, and simple social interaction with peers for support. Typical benefits included enhancements in reflective practice and decision making and reduction of feelings of isolation.

Discussion lists and listservs (Anderson & Perry, 1995; Espinoza & McKinzie, 1994) on which participants post e-mail messages to targeted groups of subscribers have also been effective educational tools. Discussions often include pre-service teachers, in-service teachers, and education faculty (Anderson & Perry, 1995). Espinoza & McKinzie (1994) set up discussion lists for graduate students to confer on issue of mutual concern.

Many studies point to common benefits of instructional activities involving electronic mail exchanges in teacher education. Among these are more active participation by students (Wolffe & McMullen, 1995), students taking responsibility for their learning, greater equity of participation (Wizer & Beck, 1996), decreasing feelings of isolation (Casey & Vogt, 1994), building of virtual communities for support and collaboration (Casey & Vogt, 1994; Hoover, 1994), and internalization of the methods into teaching practice.

Participants

The participants in this project were all graduate students in a telecommunications in education course. A prerequisite for the course was a prior technology course or equivalent experience. Therefore, the participants were not novice technology users. There was a wide range of experiences and competency levels in the group, particularly prior experience using telecommunications. The students were typically enrolled in graduate programs in curriculum and instruction or administration or were classroom teachers wanting to learn more about telecommunications.

Course Content

The course included many of the standard instructional activities associated with a dedicated educational telecommunications class. Activities included use of electronic mail, Web searching and research, Web page design and development, Web page evaluation, curricular uses of telecommunications, and exploration of emerging technologies. These topics were taught from a constructivist point using student projects. Research as the focus of class time and the class develops a Web site to display their work (Webcom Project, 1997).

To reinforce many of the curricular concepts of the course, the instructor "taught" the topic of distance education by using the on-line and collaborative techniques the students had studied. The project, Distance Education by Distance Education, provided real experiences that engaged the students in self-directed and collaborative learning and assisted them in clearly differentiating the domains of educational telecommunications and distance education.

Distance Ed By Distance Ed Project

Project Goals

The Distance Education by Distance Education Project had the following goals and outcomes for students:

1. Differentiate distance education and telecommunications as disciplines
2. Identify ways in which telecommunications is used to support distance education
3. Use curricular models found in K-12 schools
4. Practice collaboration and group processes
5. Examine a variety of resources and media
6. Apply on-line strategies to an authentic learning task.

Project Preparation

The preparation for the project included conducting readiness activities for the education students, developing project design and planning materials, locating on-line experts for the group, and locating relevant resources as starting points for the study. The project activities took place during the last six weeks of the course as a culminating experience to reinforce many of the principles and methodologies discussed and evaluated earlier in the semester.

The class component of the project began with a group discussion of the term "distance education" and what it meant to each of the students. This evoked a variety of first, second, and third generation distance education models (Jones, 1996) in which the students had participated.

To prepare for a deeper investigation, students were assigned readings (Hirumi, 1996; Jones, 1995; Jones, 1996; Sherry, 1995) which provided excellent summaries of the evolution of distance education. They were directed to explore selected Web sites (Distance Ed, 1997) that provided good overviews of the field. They were given a broad description of possible project activities and asked to prepare to collaborate on the project in one week.

Project Activities

During the project, the graduate education students participated in a range of activities to support their study of distance education. These included class field trips, group discussions, practical experiments, simple video conferencing, on-line searching, and e-mail exchanges with experts.

A considerable portion of each class during these weeks was allocated to the distance education project. The class visited the new campus distance education facility and engaged in discussions with the Distance Education Coordinator. They experimented with video conferencing. They conducted on-line research and shared results. They also decided as a group to develop a Web site to reflect their learning in this project.

One of the more interesting experiences happened quite early during the project. The students were instructed to locate on-line professional development opportunities appropriate for themselves. By this point in the term, the students fancied themselves as experts in Web searching. They used sophisticated searching techniques often involving elaborate refinements. During the discussion of the resources they located, it became clear that one method had yielded far better results in terms of quantity and usefulness than any other. The student who had been the most successful had simply followed the already-compiled indices of a popular Web search engine to a list of sites. Thus, sometimes the simplest and most obvious approach is quite adequate even for Web research.

Expert Mentors

The graduate students had studied projects in which children engaged in on-line discussions with others about topics of mutual concern, including most of the models of on-line interpersonal exchanges identified by Harris (1995, p. 130). They had located sites for soliciting pen pals and collaborators for students and teachers. To underscore the positive effects that this type of experience can have on learning and motivation, the professor arranged an electronic exchange for the graduate students.

The professor contacted colleagues around the world and asked them to serve as on-line experts for the students. Each of these individuals was involved in a different type of distance education activity or unit. They included a professor at The Open University in the UK (The Open U., 1997; Thomas, 1996) which serves a student population of over 200,000 students totally by distance, the director of a regional service center which offered television courses by satellite to secondary students across the United States (Contreras, 1993; TI-IN, 1997), a computer science professor teaching a course to multiple campuses using com-

pressed video, an Australian instructor using a variety of distance education methods with teachers, a professor in an educational technology doctorate program that included a significant on-line component, and an educational technology doctoral student participating in on-line courses.

Ground rules were set to limit the amount of time each of these busy people was asked to contribute. The dialogue was limited to three exchanges, with students posing a maximum of four specific questions on each exchange. Each expert was asked to reply to the students within one week of the receipt of a message.

The professor matched the students to the mentors, based on the students' backgrounds and professional interests. Each student was given a sheet with contact information and background information for the mentor as well as links to Web pages put out by the institution or entity connected to the mentor and recent research published by the experts describing their activities. They were directed to start by studying these resources and seeing what they could learn from the information at hand before developing interview questions for the experts.

The students discussed their mentors and findings and collaboratively identified topics to focus on with each expert. Each week, the students discussed results and determined where to head next. The major topics of interest included student populations served, recruitment of students, comparison to traditional teaching methods, assessment procedures, charges for the courses, hardware requirements for the students, certification and accreditation issues, materials and class preparation by the instructors, time demands on instructors, and overall appraisal of the distance education experience.

Representations of Learning

Since this project was a component of a real course, some structure had to be established for assessment and documentation of participation. Simple documentation was done in two ways, observation of the contributions by each student to the weekly discussions and summaries by individual students on the progress and nature of their on-line exchanges.

The professor considered the dilemma of capturing the dialogue precisely for research analysis and participation verification versus the freedom of allowing personal discussion that is not monitored. Since the participants in this project were all adults, there were other issues about the privacy of their exchanges and the appropriateness of requiring copies of all messages. The decision was modify the practice used by Broholm and Aust (94) and have the students create personal journals or summaries of their discussions rather than copy the actual messages to the professor.

The students were charged with designing more meaningful, in-depth representations of their learning as individuals and as a group. Their initial ideas included holding international video conferences or creating volumes of printed matter. The final decision was a more moderate form, a Web site (Salcedo, 1997) which could be shared and serve as a resource to others in the future.

The Distance Education by Distance Education Web site (Salcedo, 1997) was designed and constructed by the students, with the students organizing themselves into working teams to develop the site. It includes individual contributions by the student on the interactions with their mentors, group overview and findings sections, and links to other resources. Since this was a course component, the Web site development also had to be completed within the timeframe of the course. The site (Salcedo, 1997) went on-line seven weeks from the date of the beginning of the project.

Professor in the Background

The professor acted as a facilitator of the project as well as a learner herself. She provided the initial vision and structure of the project and a set of foundational resources. She also served as the liaison between the students and the mentors, maintaining contact with both groups electronically to monitor progress and address problems. She rearranged the traditional course structure to include group collaboration and discussion time weekly and provided a framework or stimulus for the discussion each week. She served as a resource and mentor as needed and as an enforcer when necessary for the group to meet schedules. Her main contribution, however, was to stay in the background and watch with delight as the students took ownership of the project.

Results

The project and its experiences allowed the graduate education students to become immersed in study as a group and to internalize their own models of collaborative learning supported by telecommunications. It easily attained the baseline goals of differentiation of distance education and telecommunications, practical application of K-12 curricular models, practical experience with collaborative and group processes, examination of a variety of resources and media, and application of on-line strategies to authentic tasks.

The project allowed the professor to transmit or illustrate concepts and principles that are often difficult to fully explore or appreciate using traditional teaching methods. The students gained an enormous amount of insight into project management from the model of the professor and their experiences in managing their project. They saw first-hand the motivational benefits of active learning that has a real purpose. They also experienced the joys and frustrations of a telecommunications project as

they encountered many of the normal problems that are associated with such projects. For example, the network went down during times planned for on-line activities, Web sites appeared and disappeared, and mentors responded at different rates.

The project also supported the findings of Wizer and Beck (96) and others of greater equity of participation. The graduate student population in this study included two students who were not native speakers. This project gave them an active role and provided direction for their discussion. It also allowed them to communicate on-line at their own speed and illustrate in written form their distinct way of communicating. It connected them to the group and let them share their unique perspective on the topic.

As in other studies (Casey & Vogt, 1994; Hoover, 1994), a camaraderie and support system developed among the students in the course. They continue to support each other in a variety of ways and actively collaborate on curricular projects. One student's project has turned into a major community project (Anderson, 1997b) with students at schools around the city adding educational resources and research to the Web page of a local historical site (Anderson, 1997a).

The project also suffered some of the persistent problems which have been noted in other studies involving on-line educational practices. Those not regularly on campus experienced difficulty with access from their schools and access to facilities at times convenient for them (Broholm & Aust, 1994; Casey & Vogt, 1994; Wolffe & McMullen, 1995). Likewise, equipment problems, technical support, and network down time (Broholm & Aust, 1994; Davis, 1995; O'Neill & Coe, 1996) also proved frustrating for the graduate students.

Issues

While the project was an overwhelming success by most measures, several issues emerged that need further investigation.

1. **The role of the professor.** Do the K-12 models of facilitator/guide work in graduate education? How should they be modified to reflect the maturity and academic level of the students? How can the professor become a learner in the process as well? What are the additional time demands on professors for facilitating such projects, maintaining regular e-mail contact with many students, providing on-going support and feedback on student progress, and preparing project materials and structures? How are these accounted for in terms of academic workload and evaluation?
2. **Location of experts/mentors for graduate students.** While there are numerous sites for locating K-12 collaborators, those directing university level on-line interpersonal communication projects have needed to be more creative in locating appropriate experts and on-line collaborators. It is not reasonable to rely on personal colleagues to support such projects. It may be that university faculty need to use methods such as solicitation from specialized listservs, collaborating with distant colleagues to find compatible groups, as well as developing Web sites for recruiting collaborators at the university level.
3. **Maintenance of confidentiality/privacy of mentors.** What methods need to be used to insure confidentiality of mentors as well as to insulate them from further solicitation by others? How does one illustrate the validity of the research and expert contributions without publicly exposing direct information about the experts? Is this problem more serious in an on-line study involving a widely available Web site than it would be if the final product were a printed article?
4. **Modifications based on class size.** Since the class involved in this project was relatively small, it was not difficult to arrange for a mentor for each student. What models should be used if classes are larger or if only a few experts are available? Should the entire group concentrate on one project or should there be several projects? How are students grouped and organized for projects? Can this approach be modified for any class or are there practical limits to the class size?
5. **Network access outside class.** Technical problems and access to network resources are still major barriers in on-line projects. Is it fair to assign projects that require that students have or find regular access? How do you handle or prepare for network difficulties when classes are planned around on-line activity?
6. **Appropriateness of the experience for graduate students.** Is this type of project appropriate and reasonable for a graduate class? How much class time should be allocated versus outside time? Should graduate credit be given for courses with such practical components? The course and its projects clearly tested the bounds that many have set for graduate scholarship.
7. **Permanence/maintenance of Web site.** How long should this Web site and others created by students be kept on-line? Who should maintain them? Who owns or should control this intellectual property? Is it acceptable for future students to extend the academic product started by others?

Conclusions

The Distance Education by Distance Education project was an excellent vehicle for graduate study and for providing students with an insight into the practical impact of using technology to support instruction. The basic model works well in a graduate setting and can be replicated or modified easily with similar results. Electronic message sharing is a technology that is not new but is still a

fundamentally sound and exciting way to use technology to support learning.

Through expert mentors and on-line resources, the graduate students in this project were able to explore their research topic in ways not possible if limited to traditional methods using materials at hand on campus. They became excited about learning and learning together. They took responsibility for their learning and continue to seek more learning opportunities, courses, and challenges.

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Teaching and Learning Online: Tools, Templates, and Training

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The 22-campus California State University (CSU) system recently sponsored an on-line faculty development institute to help college instructors learn how to create pedagogically sound on-line instruction. The workshop is now available to interested faculty and institutions throughout the world. This paper describes the genesis of the online workshop, describes the underlying instructional principles, presents an overview of the workshop modules, and reviews the lessons learned from the project.

How the Online Workshop Came About

Higher education faculty are content experts. Most were not hired for their teaching ability or teaching experience. Few were screened for their computer skills, and, it's probably safe to say, almost no search committees include web development skills in their criteria. Once on campus, faculty are busy teaching, researching, and performing community service. Those with the inclination to develop web-based courses almost certainly don't have the time to do so, particularly if they are young, enthusiastic, and untenured. That a few faculty do develop web-based material is remarkable, but their exceptional successes prove the rule.

As educational technologists, we were interested in providing an environment in which faculty can continue to be what they are—content experts, with perhaps a feel for and, ideally, some experience in teaching. That meant providing significant support both for developing sound pedagogy and for the technical aspects of web development. To try to meet these requirements we decided to put together a suite of templates that reflected both "best practices" from an instructional design perspective and simplicity and robustness from a technical standpoint.

We designed the Tools, Templates, and Training (T3) workshop to provide instructors with the conceptual understanding they need to develop and manage online course materials and activities, along with some automated tools and templates to relieve them of complex technical tasks. The workshop went online in May, 1997.

The first participants to participate in the workshop were so-called "lead faculty" and "staff" on most of the CSU campuses. Ideally, one or both of these individuals had some prior experience developing an online course, or parts thereof. These individuals would take the course, receiving intensive support from graduate students at SDSU, and would then be responsible for providing the same type of coaching and mentoring for two additional faculty on their own campus as they participated in the online workshop.

Finally, the two additional faculty were each to recruit and coach three other faculty interested in developing online course material. The idea was to create a critical mass of capable faculty on each campus to coach and mentor others as the need arose. We at SDSU provided software tools and support for the first tier, software tools only for the second tier, and nothing for the third tier.

Implicit in the design of the T3 workshop was the need to model effective online course delivery for faculty. This modeling would help each participant to feel what it's like from their students' point of view, thereby providing them with insight into how to design their own courses. It would also give them a fully-worked example of how an online course can "look and feel," to aid them in making decisions about their own courses.

Underlying Design Principles

Toward this end, the workshop was designed to foster immediate success and encourage incremental development of online course materials. Faculty could begin with just a page or two, work up to a course module, and eventually understand the scope of effort necessary to scale their online modules to a full online course. The workshop facilitated faculty as they developed online course modules by providing templates to help create a course "marketing" page and instructor home page, then moving on to course pages such as a schedule and information page, and finally creating an instructional module using both innovative and traditional instructional strategies.

Perhaps the most important design principle was the idea that both instructors and students benefit from having a "mental model" of the course. Stop reading, close your

eyes for a moment, and notice what you "see" when you think of a course you teach regularly. Did you "see" a kind of abstract diagram with a bubble or "chunk" for each week or each class session? Did you "see" your syllabus? Did you "see" the room in which you last taught the course, along with the students and the entire classroom environment? Did you "see" yourself talking with a series of students who have taken the course in the past?

Whatever you "saw" when you thought of your course is probably closely related to what we mean by your "mental model" for that course. It's what helps you organize the course in your head. Students, too, have mental models of their courses. They may be related to the materials, such as texts used in a course; to the physical space, such as a classroom, they associate with the course; to the other people involved in the course; or perhaps to timelines of assignments or coming due or the course meeting schedule.

These mental models are what help both instructors and students organize their experience of the course. A clear mental model will presumably help instructors create clearer courses and help students organize their course work more effectively. In any case, we realized that students taking online courses have mental models as well. We hypothesized that by creating a clear course structure, we could facilitate students generating a clear mental model of the course, in turn helping them succeed. We further reasoned that if the course structure reflected the course pedagogy, or instructional design, it would further help both instructors and students think clearly and usefully about the course.

An Overview of the Workshop

To this end we devised a course design based on a simple pedagogical model. We designed each module in our online workshop around this five-step model, which we call the "I CARE" system. I CARE stands for "Introduction, Connect, Apply Reflect, and Extend." I CARE is distilled from basic instructional design practice, adapting various systems or "steps of instruction" to what seemed to us to be particularly useful components for an online course.

Synchronous, face-to-face courses usually entail regularly scheduled meetings, and course syllabi are typically organized around that schedule. Since many online courses tend to have a strong asynchronous component, or even be entirely asynchronous, we divided our course into "modules" or "sessions" rather than "weeks" or "dates." This recognized learners' prerogative to organize their course time around work, family, and other commitments, while maintaining a modular structure of "do-able chunks" arranged in a progressive series.

Each module, in turn, represented a pedagogically complete "lesson" that can be completed in roughly the equivalent of the time a student would devote to a face-to-face class session and corresponding out-of-class work. Thus, in our online workshop, each module or session was implemented using the I CARE system. Each of these sections are designed to enhance students' learning opportunities.

Introduction

The introductory section serves to place the present module in the context of the course as a whole, and enliven learner's prior knowledge with regard to the content that is about to be presented. This section should include clearly stated objectives for the module so that learners know exactly what they are supposed to be "getting" from the module. The introduction may also provide motivational elements, such as a scenario that poses a familiar or relevant problem for learners that may be used in subsequent sections as well.

Connect

The connect section is primarily for presenting new information in context. It may consist of online text with appropriate visualizations, such as charts, diagrams, illustrations, visual analogies, and other media elements such as sound or appropriate virtual environments. Alternatively, it may consist primarily of instructions to read offline text material, view a videotape, or listen to a sound recording. The connect section should be designed to help learners organize the new material in the context of what they already know, and prepare them to apply this information in the next section.

Apply

This is the practice section of the module. It might involve writing a short paper or a section of a longer work. It could involve a hands-on project such as classifying rock samples (virtual or actual), analyzing earthquake patterns, or developing a web page. It might be an individual or small group project, or involve students interviewing local subjects or subject matter experts. You might implement the apply section using a WebQuest (Dodge, 1997), a prompted writing tool, an interactive online experiment, or simply provide instructions for an offline activity you wish students to complete. Students might create a concept map or draft a plan. In short, any activity that gives learners a chance to try out their new information in an appropriate context is fair game.

Reflect

Often the least valued—and frequently one of the most needed—stages in a pedagogically sound lesson is to give students an opportunity to reflect on their newly acquired skills and knowledge. This might take the form of a thoughtful response to a carefully crafted question from the instructor, or a peer exchange about lessons learned, insights gained, and so forth. It might be implemented through an online chat or a more deliberative online forum. You might ask learners to keep an electronic journal to submit or use in a later assignment.

Extend

Like the introduction, the extend section has many possible functions. It can provide closure, prompt further exploration and learning, assess students' skills and knowledge, give students an opportunity to evaluate the course itself, or all of the above. This is a good place to provide references or resources "for further information" or for advanced work on the topic.

The T3 online workshop describes the I CARE system, models it for workshop participants, and provides other examples of I CARE and other pedagogically sound systems for organizing online learning. The workshop consists of a five-module on-line course featuring:

1. Strategies and tactics for on-line teaching and learning: Benefits and limitations of on-line learning. Identifying course content appropriate for on-line delivery. Implementing traditional pedagogies on-line. New possibilities and opportunities for teaching and learning on-line. Best practices in on-line instruction and education.
2. Document preparation for on-line courses: Using specially designed templates for helping professors quickly and easily mount course-related web sites. The I CARE (Introduction, Connect, Apply, Reflect, Extend) system. Using HTML editors; preparing graphics and media files. Converting existing text (word processing) files for delivery via the world wide web.
3. On-line student learning activities: Organizing selected course content around on-line learning activities. Best practices in on-line learning. Creating activities that are easy to implement and maintain. Questing the web in search of content, activities and other resources.
4. Growing an on-line learning community: Facilitating on-line student communication by designing and managing on-line forums and chats. Creating and maintaining student document exchanges.
5. Management of on-line course resources: Developing and maintaining course-related on-line publications and activities. Strategies for increasing personal productivity as an author and manager of on-line course resources. Developing a plan for gradual improvement of on-line course-related content and activities. Identifying local campus support for web-based publishing.

This approach is applicable to the development of on-line courses in all disciplines, but is particularly suited to teacher training and school leadership development courses because it models sound teaching and learning practices. In addition to the original 40 or so CSU faculty who developed course modules as part of their participation in the Faculty Development Institute, we have received requests from a number of individual faculty and faculty development coordinators at a variety of universities throughout the country who are interested in using the online workshop on a personal or institutional basis. The course is free, entirely asynchronous, and will be maintained indefinitely on SDSU's web servers.

The T3 online workshop is located at http://clipt.sdsu.edu and click on "T3."

In addition to the many examples by workshop participants (click on "People" in the T3 menu bar), several examples of entire courses developed using the T3 approach are also available for scrutiny.

One such example is the course "Technology for School Leaders" that provides K-12 principals, technology coordinators, and lead teachers with the "big picture" of school technology integration (pro and con). It helps them "speak the language," assess their schools' specific technology needs, and plan for effective classroom implementation. The course may be viewed at edweb.sdsu.edu/courses/edtec596r/index.html.

Lessons Learned

We understood from the beginning that a team approach to online course development would be useful. Our experience developing and implementing the online workshop underlined that idea again and again.

During the development phase, for instance, we benefited greatly from the collaboration of a team of three faculty and four graduate students. The faculty were able to help generate, review, and revise one another's work. The graduate students helped draft modules, implement web page layouts and visuals, and provide technical support for tasks like web page-database interactions.

On the workshop participant side, our intention was to foster strong campus development teams by training and supporting strong lead faculty and staff on each campus, who in turn would coach and support additional faculty. To this end we attempted to screen prospective lead faculty and staff for their past experience with online course development or related tasks. On some campuses, however, adequately experienced volunteers were not forthcoming, and we "settled" for less skilled, albeit highly enthusiastic, substitutes. This resulted in mixed success for the initial workshop. On the majority of campuses, where lead faculty were both proactive with respect to their leadership role and already had at least a modicum of experience in web development, the workshop flourished and faculty participants raved. On a few campuses, where lead faculty themselves were floundering in technical problems or failed to provide leadership for the other faculty, the workshop fizzled. We concluded that, while the idea of screening onsite leadership is sound, the implementation, including followup support, is crucial and should not be compromised.

This and other evidence also led us to conclude that we had been over-confident about faculty ability to author online courses. As noted above, we aimed the course at faculty with little or no web development experience (with the exception of lead faculty), which describes most of the

faculty in our institutions of higher education. We hypothesized that by providing easy-to-use tools (such as Claris HomePage for web page authoring), instructionally sound templates for courses and course modules, and training consisting of the online workshop itself with coaching from lead faculty and staff on each campus, that faculty could successfully author good quality online courses.

This proved only partially true. While many participants raved about the I CARE system and the workshop as a whole, others reported occasional to chronic frustration. The experience of one participant is instructive. A history professor who joined our workshop was an outstanding teacher who had participated in experimental two-way interactive video courses in past semesters. He was enthusiastic about putting parts of his course online and plunged into the T3 workshop with characteristic energy.

Despite his background as an instructor with a proven track record teaching with technology, his computer got the best of him. In the context of his interactive video course, the technology was handled by a team of video production experts. He had only to adapt his teaching style to the constraints and affordances of the technology. In our workshop, he was asked to actually handle the technology himself. He did not give up easily. He solicited and received the support of his campus T3 staff person, who visited him in his office and tried to help him work out the technical problems he was experiencing. Nevertheless, the technical problems did not go away. Eventually he threw in the towel and reluctantly resigned from the workshop, explaining that he had come to the realization that he would need to spend an inordinate amount of time simply getting his computer system up and running in a useful way, and that he was, rightfully, unwilling to commit that time in addition to the time it would take to participate in the course as well. While this was an extreme case, it is probably familiar at least in kind to anyone who has attempted this type of development.

This and other participants' experiences led us to reformulate our thinking about how best to foster online course development in higher education. We realized that most faculty not only don't have the requisite instructional, media development, and technical skills to single-handedly author online courses, but that they are unlikely to develop those skills to any significant degree through a workshop such as ours. The overall success of the T3 workshop was probably more a result of self-selection by faculty who were already sufficiently "technology-ready" and able to either provide or seek out adequate technical support. They probably represent a minority of current faculty, and that demographic seems unlikely to change significantly in the near future. Moreover, it is probably not useful to expect most faculty who are not at a level of technological sophistication to author online courses by themselves. Like our history professor, it is probably too time-consuming, and perhaps in some cases altogether impossible, to acquire those skills lacking the requisite aptitude. The solution to this problem seems to be the return to the team approach as described in the beginning of this report, but with an even greater emphasis and support.

In addition to the team approach, there appear to be four additional skill sets required for successful online course development. The first is expert content knowledge as provided by a faculty member. Content expertise is what they were trained to do by their degrees, hired to do by their peers, and regularly assessed for with respect to promotion and tenure. That said, we would suggest that even here there is much to recommend a team approach. With several faculty on a development team, there is more opportunity for quality assurance through collaborative generation and peer review of both content and pedagogical strategies. Since online and other distributed learning courses will potentially be seen by many more students than a similar face-to-face course, with the correlate that the institution as a whole will be judged to a greater degree on the overall merits of these course "products," it seems worth the extra effort and expense to ensure only high quality offerings in the online arena, particularly with respect to content.

The second skill set, instructional design, is a little more ambiguous. While usually untrained in teaching, many faculty have nonetheless become good or even great teachers, and others are willing and able to learn to become good pedagogists, particularly in the context of systematic development of online courses which does not rely heavily on personal characteristics such as charisma or "presence." But in cases where faculty may not have sufficient experience or interest in pedagogy (or time to devote to it), the course development team should include a professional instructional designer. Instructional designers are trained to work with content experts, media developers, and technicians to develop instructional programs or products, and are often skilled in project management as well.

The generation of media products is the third skill set. Online courses depend almost exclusively on media products, be they books, web pages, videotapes, or CD-ROMs. Neither faculty nor, for the most part, instructional designers, are trained in media production methods such as graphics, video, and multimedia development. These require competent artists, video production personnel and multimedia developers. This may be a team of 30 to 40 people at one extreme (as is the case in British Open University development teams, for example), or merely a skilled graduate student or two. In either case, these individuals are typically not trained in *instructional* graphic, video, and multimedia development, and need to work together with faculty and instructional designers to create effective online courses.

The fourth skill set emerges out of the present state of online course development, which is characterized by an

expanding tool set of primarily computer-based technologies. What was once limited to inserting a few strategic html tags has become a rather staggering array of far more complex technologies, such as Java and JavaScript, Shockwave movies and their requisite "plug-ins," CGIs, forms, web page-database interactions, frames, layers, image maps, archived and real time streaming audio and video, and much more. While these technologies offer useful strategies for online teaching and learning, the sheer number and complexity of these new tools leave most of us gasping for air. Serious online course development efforts must include dedicated technical support staff to set up and maintain servers, load and maintain software, and to consult on bandwidth and compatibility issues.

These four "skill sets" (content expertise, instructional design, media production, and technical support) seem to be the basic components of effective online course development teams.

Another lesson learned from developing and implementing the T3 online workshop was the value of various methods of support. As described above, most participants in the original workshop were either screened by T3 staff or self-selected, probably to a large extent for technical aptitude. Even so, several faculty participants needed direct support from the T3 staff. One tool we found particularly useful for direct coaching in technical areas was screen sharing software, in our case, Timbuktu (Netopia, 1997). On several occasions T3 graduate assistants or faculty in San Diego assisted workshop participants in distant parts of the state by accessing their computer screens on our own screens, and even controlling their mouse and keyboard to demonstrate techniques while talking with them on the telephone. This software was easy to install and use, and worked flawlessly, even across platforms, with reasonably fast Internet connections being the only requisite.

Finally, throughout the time we have been developing and implementing the T3 online workshop and other online courses, we have become aware of a kind of "natural" taxonomy of development activities. We could describe them as development on the "learning activity" level, the "course" level, and the "program" level.

Most faculty and even institutional effort, including the T3 workshop, is focused primarily on the course level, dealing with the practical concerns of getting courses online in much the same way we put a course into the classroom. But one of the lessons learned from veteran distance learning providers is that we would do well to think also in terms of whole programs, when viewed from a "marketing" perspective. If one of our goals is to attract new students (in order to enhance quality, diversity, revenue, or all of the above), they are more likely to come to an integrated certificate or degree program than they are to seek out a single interesting course.

At the same time, perhaps the most manageable realm in which to develop is the "learning activity" level. Almost any individual or small group of faculty can manage development of small, well-designed online learning activities. Wonderful examples of these are the Virtual Flylab and the Virtual Earthquake (http://vflylab.calstatela.edu/Welcome.html). This level is particularly appealing because online course developers could potentially pick and choose these activities for their online courses in the same way we pick and choose journal articles for reading packets. Drawbacks to this level of development activity include figuring out how to pay for it (grants? subscription fees?) and server and software maintenance issues.

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Training Centres: An Architecture for the Realisation of Open and Distance Learning Environments using Telematics

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The rapid technological advancements and their impact were recognised by the European Union which assigned the task of investigating the various trends and of defining the needed actions to the Bangemann Commission. The commission in its report defined ten sectors to which priority should be given and in which the teleworking and distance education activities were included.

The aim set by the Bangemann Commission for the area of distance education is the provision of a continuous educational process which will satisfy the needs imposed by an ever shifting and changing society. The achievement of this aim is envisioned through the following actions:

- The establishment of distance education centres. These centres are expected to fulfil their purpose by making extensive use of Telematics and network-based distance education software.
- The establishment of advanced distance education techniques to schools and universities.

The application of the above structures is expected to offer advantages to:

- the industry, especially to the SMEs, and to the public sector since it will allow the education of staff members with lower costs and with better utilisation of the finite available educational resources,
- the employees who need to upgrade their knowledge and skills,
- the people who are either unable to move outside of their houses or reside at remote geographical areas,
- the students who seek to have access to educational material of higher quality than the offered one.

The trends noted above result in a need for training people in the use of the New Information Technologies (NIT). Significant help, towards the satisfaction of this need, can be acquired by the use of Telematics.

The TRENDS Project

The TRENDS Project aims at the development and efficient delivery of in-service training to school teachers. The methodology focuses on the enhancement of existing ODL techniques, in the area of multimedia telematics. The objectives of the project are:

- The development of an in-service, school based teachers training system, based on multimedia telematics, to support the continuous improvement of teachers' skills and capabilities in Secondary Education, in Europe.
- The implementation of distance learning techniques, to provide viable and cost-effective school based training.
- The establishment and operation of a European Teachers' Training Network, to provide the distance training.
- The validation of the distance training services, by training 2,400 teachers from 120 European public secondary schools.

Training Centres: A Centralised Architecture

For the uniform provision of the services that will be offered by the TRENDS Network at a pan-European level and the enhancement of co-operation of the participating countries in various educational issues, the six national sites, in Greece, Italy, Spain, Portugal, France and United Kingdom, will be interconnected through mature network technologies (Euro-ISDN, TCP/IP protocol suite), so as to act as service providers to the teachers in their schools.

The basic idea of the TRENDS network is that the six Training Centres (one per participating country) will have to interact with each other transparently and will play the role of the educational services provider in their National Teachers' Training Network. The same idea could be applied to every organisation planning to offer similar educational services, either to a national or international

level. The outcome of such an implementation would be the establishment of an educational network.

The Training Centres approach to the realisation of Open and Distance Learning Environments is a centralised architecture with the following advantages:

- The Training Centre can be hosted on the premises of an educational authority, who will be responsible for the content and the model of the offered services.
- The technical support will be much more efficient if the hardware and the software modules involved reside in the same place.

The establishment of a Training Centre should be preceded by a feasibility study, aiming at defining the context into which a Training Centre will operate. The following parameters have to be considered as critical elements to be discussed and investigated, in order to cover the aspects considered as most important in the Feasibility Study for the establishment and operation of a Training Centre aiming at supplying Open and Distance Learning Services.

A Training Centre should be considered as a distance training services provider that is going to address the needs of the client (society), for the provision of educational services in the context of the life-long learning.

When devising, developing and putting into practice services (or training services, as it is happening in the TRENDS context) three major elements need to be taken into consideration: the *implementation environment* representing the context into which learning technology products and services are placed; the *implementation design* comprehending the analysis of the opportunities present in the implementation environment, the formulation of implementation strategy and plan of action; the *action* occurring as a result of the implementation design and corresponding with service delivery.

The concept of implementation environment includes the understanding and characterisation of some other components which are necessary in order to develop properly the feasibility study. This is to say, the factors involved in the implementation, the "market" structure and the related socio-economics dynamics. What is intended for "market" structure is obviously influenced by the institutional context in which training takes place.

Once the scenario is created in which the Training Centre is supposed to supply its services, the other side of the coin to be surveyed consists of the innovation dimensions which come up and affect the creation of a feasibility study.

They are respectively technical, economic and organisational. Another basic innovation dimension is the pedagogical one. A training model should be established that is a model through which the training services are going to be offered. This training model is a very important phase in the feasibility study of a Training Centre. It will affect the content of the training material used and the evaluation method of the trainees. It is deemed imperative that the training model needs to be decided, applied and monitored by education experts.

Here it is worth saying that, from this standpoint, any effort will have to be done to put into operation some general principles underlying the design process:

- to make explicit the new educational concept underlying learner-based systems which are centred on the learning-paradigm rather than the teaching paradigm, namely on knowledge acquisition rather than knowledge transmission;
- to guarantee a maximum level of interaction between trainees/teachers and among the trainees themselves (this in the perspective of an evolution towards distance training systems of third generation);
- to foresee communication flows to collect bottom-up suggestions.

When selecting a technological configuration for a certain learning environment, the technical feasibility involves the consideration of some factors such as:

- *learning functions* (transmission of knowledge and information communication among trainees, tutoring, guidance, exercises, etc.).
- *key features* (real time, delayed time, one-way, two way, one to many, many to many, use of text, use of sound, use of still images and use of moving images).
- *technology components* (they cover a full range of delivery mechanisms based on information, telecommunications and multimedia technologies).

The economic feasibility can be considered from two different viewpoints: the former concerning the provision of services, which is more focused on the survival of the product/service, the latter concerning the adoption of the product/service and more focused on questions about cost, economic efficiency, risks and investments.

Finally, the organisational feasibility requires to foresee the necessary measures to prevent organisational problems from being obstacles in implementing the training scheme and to design roles and functions to maximise efficacy and compatibility of it within the organisational context of implementation.

Also in this case, as in the one of the pedagogical dimension, the respect of some general principles underlying the design process needs to be guaranteed.

This is to say that:

- the outcome of the services offered from the Training Centre has to work as an engine for additional/complementary initiatives at regional/local level,
- training practices based on networks and distributed systems have to be embedded in the mainstream of re-

education activities, and
- training services need to be consistent not only with present competencies that are required but also with the ones they may be required by the coming rapid reforms concerning the working class of the years to come.

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What Are The Most Important Teaching Behaviors for Distance Instructors? Perceptions of Facilitators, Instructors and Coordinators

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Distance education is a rapidly developing instructional approach used by educators through the world. For this teaching technique to be highly effective, it is imperative that those using the system for instruction be trained appropriately (Barker & Dickson, 1996; Moore & Kearsley, 1966; Willis, 1994). Over the past decade distance educators have increased the development of guidelines for what constitutes effective distance instruction (Mc Kenzie & Davidson, 1997; Ciardulli, 1996; Dilllon, & Walsh, 1996; Thatch, 1995; Wolcott, 1995). A review of the literature, however, found nothing dealing with the identification and validation of the most important teaching behaviors displayed by distance instructors. The purpose of this study was to twofold: (1) to validate a list of distance teaching behaviors collected by the research team and (2) to develop training guidelines on the most frequently observed and the most important behaviors of distance instructors.

Methodology

A validation instrument was designed by the research team. Forty-one teaching behaviors: extracted from an extensive review of the distance education literature, discussions with distance trainers, teachers, and researchers, and the research teams' observations of distance classes. The instrument used a 5-point Likert scale. Respondents were asked to indicate on that scale how frequently they had observed the distance behaviors and how important they felt the behaviors were in delivering effective distance classes. On the importance dimension a 5 on the scale indicated that the behavior was "critical, required or necessary", 4 = "very important," 3 = "important," 2 = "somewhat important," and 1 = "unimportant." On the frequency dimension a 5 indicated that the behavior occurred "very frequently," 4 = "often," 3 = "sometimes," 2 = "seldom," and 1 = "never." This paper will report only on the importance findings.

The survey was distributed to thirty college and university distance education sites in Georgia in the spring of 1996. Distance coordinators at each of the sites were asked to complete and return a survey as well as to distribute three surveys to distance instructors and facilitators at their institution. Two hundred and ten surveys were mailed.

Analysis

Seventy three surveys were returned to the research team. Of these only sixty eight were used in the data analysis due to missing demographic information. The data were analyzed using SPSS to compute the mean scores and standard deviations. The mean scores on the importance dimension were then ranked from the highest to lowest.

Demographic Findings

The majority of the respondents were distance learning coordinators, female, and from comprehensive universities. Most of the respondents had observed/ taught one distance class. This was followed closely by respondents who had observed two to five distance classes. Table 1 below summarizes the study's demographic findings.

Important Behaviors Findings

One of the forty-one behaviors was considered to be "critical" to effective distance instruction. This behavior dealt with arranging for materials such as handouts to be delivered to off campus sites as needed. The majority of the behaviors (N = thirty-five) were considered "very important" while five of the behaviors were considered "important."

Table 2 summarizes the importance findings. It is interesting to note that all of the distance behaviors scored above a 3.0 on the 5-point Likert scale and that the majority of the behaviors dealt with classroom management behaviors (N=17) followed by instructional (N = 14), technical (N = 5), assessment (N = 4), and dress (N=1) behaviors .

Table 1.
Demographic Data

1. Position:
   Distance Learning Coordinator (N=48 / 65.8%)
   Facilitator in distance class (N= 16 / 21.9%)
   Distance Teacher (N=4 / 5.5%)
   5 missing cases (5.48%)

2. Gender:
   Female (N=40 / 54.8%)
   Male (N=32 / 43.8%)
   1 missing case (1.4%)

3. Institution:
   Comprehensive University (N=35 / 47.9%)
   Regional University (N=18 / 24.7%)
   2 Year College (N=10 / 13.7%)
   State University/Senior College (N=8 / 11%)
   2 missing cases (2.7%)

4. Experience in observing/ teaching distance classes: (A distance class is considered to be one session that was observed or taught via GSAMS)
   Observed / taught one distance class (N=28 / 38.4%)
   Observed / taught 2-5 classes (N=26 / 35.6%)
   Observed/taught 6 or more distance classes (N=16 / 21.9%)
   3 missing cases (4.1%)

Table 2.
Distance Instructor Behaviors Ranked by Importance

Behavior	Mean	S.D.
The distance instructor.....		
1. arranges for materials such as handouts to be delivered to off campus sites as needed (management)	4.53	.91
2. communicates expertise and knowledge of the class content (instructional)	4.49	.86
3. encourages active class participation (instructional)	4.48	.85
4. has emergency phone numbers for problem solving at sites (management)	4.47	1.07
5. begins class on time (management)	4.40	.95
6. uses proper grammar and avoids the use of vulgar and slang expressions (management)	4.39	.94
7. checks the placement and clarity of the visuals on the overhead projector (technical)	4.37	1.16
8. clarifies assessment methods and expectations to students (assessment)	4.34	.93
9. makes sure students know how to signal and interrupt the instructor when problems develop (management)	4.33	.99
10. looks at students in class at the delivery site and directly into the camera to students at remote sites when making presentations (instructional)	4.33	.91
11. develops a backup plan for emergencies (management)	4.32	1.06
12. repeats students' questions for clarity before responding (instructional)	4.32	.89
13. develops rapport with students (management)	4.30	.95
14. is sensitive to students' comments (instructional)	4.29	1.09
15. sets realistic expectations on what can be covered in each distance session (management)	4.29	.91
16. encourages open dialogue between students (allows alternating responses on and off site) (management)	4.29	1.03
17. designs effective visual aids for distance education classes (instructional)	4.29	.91
18. uses a variety of teaching modalities such as lectures, discussions, role playing and hands on learning opportunities whenever possible (instructional)	4.28	1.02
19. gives immediate and effective feedback which includes both specific and general praise (instructional)	4.22	.97
20. incorporates time for a variety of activities such as small group discussions, videotapes, the Elmo, etc. (instructional)	4.22	1.02
21. when called for, uses distance education equipment with care and expertise (technical)	4.15	1.17
22. prepares to facilitate discussion between and/or among sites (management)	4.14	1.10
23. uses e-mail, the phone, and/or fax when possible(technical)	4.14	1.00
24. is aware of students' names at all sites (management)	4.13	1.15
25. varies voice inflection when delivering instruction (instructional)	4.13	.98
26. keeps students informed of their expectations including what they are to be doing in class		

	(i.e., listening, taking notes) (management)	4.10	1.19
27.	uses longer "wait time" for responses to questions and comments (management)	3.97	1.11
28.	checks students perceptions about their distance experiences (assessment)	3.93	1.07
29.	utilizes problem solving exercises such as discussions or written assignments to assess students' progress (assessment)	3.90	1.13
30.	uses informal assessment techniques such as class participation and observation to assess the degree of success of the course (assessment)	3.83	1.28
31.	is aware of student movement at all campus sites (management)	3.81	1.14
32.	establishes cues that are communicated to the students to let them know when the class is beginning and ending (management)	3.81	1.15
33.	provides class outlines for sessions (instructional)	3.77	1.32
34.	provides content reviews at the beginning of class, during the session, and at the wrap up (instructional)	3.74	1.09
35.	uses humor in class without sarcasm (instructional)	3.67	1.21
36.	wears clothing that is complimentary to the learning environment (dress)	3.54	1.23
37.	utilizes group processing skills (instructional)	3.45	1.38
38.	instructs students on the proper use of the equipment (technical)	3.44	1.41
39.	uses site facilitator to assist with the delivery of class (management)	3.25	1.46
40.	uses e-mail to send assignments and progress reports to students at all sites (technical)	3.34	1.36
41.	assesses students' prior experiences with distance education (management)	3.14	3.03

Conclusion

The results of this study, while no means conclusive, are a beginning in what will be a difficult and continuous process of identification and validation of what constitutes the uniqueness of effective instruction in the distance classroom. It is the researchers' hope that this work will be useful for training, evaluating/assessing, and/or improving distance educators and what they do in the classroom.

Where to Next?

More research on a variety of issues regarding instruction in distance education is needed. Prominent among those issues are these:

1. What do students in distance education courses identify as the most effective teaching behaviors of instructors?
2. How do effective behaviors identified by different groups (students, facilitators, trainers, etc.) compare?
3. Are there (a set of) generic teaching behaviors all instructors in distance education must master in order to be effective?
4. Does teaching style alter what constitutes effective teaching behaviors?
5. Does the content of the course to be taught influence what is considered to be effective teaching behavior?

As the world grows smaller the need for more educational opportunities for more people in more places will become epidemic. Effective distance education programs led by effective distance instructional specialists will have to be one of the cures.

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Taking Instruction Online: The Art of Delivery

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The notion that people seek to make meaning out of their world, whether it is the classroom or the living room, is not a new one. Educational philosophers and learning theorists have attempted to explain how learners learn and construct meaning from instruction or the classroom. *Stimulus-response* theorists (Thorndike, Guthrie, Pavlov—as cited in Hilgard & Bower, 1966; Watson, 1960; and Skinner, 1960) view learners as reactive, passive robots only responding when stimulated by something outside of themselves. Reese & Overton (1970) propose to call this the mechanistic world view—any change in the learners comes from outside of themselves. *Organismic* theorists (Dewey, Tolman—cited in Kingsley & Garry 1957; Lewin, 1951; Combs & Snygg, 1959; Bruner, 1968; and Freire, 1970), on the other hand, contend that learners are active, organized entities who seek meaning from their own experiences to solve problems; to create relationships between signs and desired goals; to manipulate information and knowledge to fit new tasks; and to evaluate whether the way they have manipulated information is adequate to the task. The desire for self-actualization is the driving force which motivates the behavior of organismic learners.

Constructivism is a theory about knowledge and learning that draws on a synthesis of current work in cognitive psychology, philosophy, and anthropology (Kuhn, 1962; Piaget, 1970; Sigel & Cocking, 1977; von Glasersfeld, 1981; Bruner, 1985; Gardner, 1991). Constructivist theory defines knowledge as temporary, developmental, socially and culturally mediated, and non-objective. Learning from this perspective is a self-regulated process which seeks to resolve inner conflicts that arise from concrete experience, collaborative discourse, and reflection (Brooks & Brooks, 1993). Simply stated: learners construct their own internal understandings of the world in which they live.

The concept of adults as learners emerged both in this country and in Europe shortly after the end of World War I; however, only in the last few decades has the theory of adult learning matured. Knowles, Thorndike, Sorenson, Tough, Lindeman, Cross, Darkenwald & Merriam, and Houle, among others, have written extensively on the idea of the adult learner. The term, andragogy, has appeared as the label which differentiates adult learning theory from pedagogy, youth learning theory. The andragogical model of the adult learner is based on the assumptions that adults need to know; adults have a self-concept of being responsible for their own decisions and for their own lives; adults come into education with a greater volume and a different quality of experience from youth; adults come ready and motivated to learn what they need to know in order to cope; and while adults are aware of external motivators (better jobs, promotions), it is internal pressures (job satisfaction, self-esteem, quality of life) that are the most potent motivators (Knowles, 1990). Adult learners cannot help but try to make sense of their environments.

Distance Learning Theory

Distance learning seeks to provide education at a distance. Inherent in this telecommunications technology is the introduction of activities, tools, and instructional designs for which the learner may have no frame of reference. The normal model of one teacher and a single class of students in the self-contained classroom does not fit the distance learning training model. The television camera provides the teacher a view of multiple classrooms in which various kinds of learning media must be implemented. The old classroom star configuration—the lecturer reaching a finite number of students—does not apply in a situation where the teacher only has face-to-face interaction with students via the television screen. Student and teacher learning and interactions are changed (or, at the least, modified) in the distance learning environment.

Tough (1979) has suggested that when learners approach a new learning task [e.g., understanding the distance learning classroom], they cast around for some analogous situation from the past to give guidance as to how to approach this new situation to determine the benefits to be gained in learning from it. Students trying out this medium for the first time receive little guidance about how to participate, organize their lives, interact with online materials, reflect, express themselves online, and use the online experience for successful completion of the course. Smith (1982) has suggested that learning-how-to-learn

(LHTL) strategies may assist students and teachers to make sense of a new learning environment. LHTL is defined by Smith as "possessing or acquiring the knowledge and skill to learn effectively in whatever learning situation one encounters" (p.19). LHTL theory suggests that learners rely on a "bag of tricks", tried and true approaches, prior learning strategies and tactics, and what worked in other situations to make sense of a new environment. Eastmond (1995) has indicated that these factors may include prior experience, the role of the support person, a frame of reference, relationships between and among students and teachers, acclimation to information and sensory overload, role of participation, and processing the small picture.

Recently, Sherry and Wilson (in Khan, 1997) have offered another view of learning: *transformative*. The transformative view of learning combines the ritual view of instruction which communicates and perpetuates tradition with the transmission model of instructor-as-expert deliverer of instruction. In the transformative view, both the teacher and the student alike are *transformed* into learners by the process of communication. A two-way dynamic comes into being as distance learning modalities are used to deliver instruction. The learner can pause and reflect on what he or she is learning; the instructor can develop new understandings of the subject and the learner.

This paper focuses on the process of preparing and delivering courses using compressed video by considering research related to how learners adapt in new environments, the approval process, the environment, and course delivery techniques. Implications for pre-service and in-service instruction, graduate teacher education faculty, and faculty and staff development will be offered.

Methodology

Over a two-semester period, a survey has been administered to students in distance learning courses to address the issues of adjustment to the environment and technology, methods and interactions utilized by the instructor, and related experiences which provide the framework for adapting to the distance learning classroom. Specifically, the survey has focused on answers to the following questions:

1. How do students make sense of distance learning technology?
2. What mechanisms do students employ to adapt to a media-rich learning environment?
3. What external or internal motivations allow students to succeed in a media-rich learning environment?
4. What social interactions are employed to help students master and use the technology in the distance learning classroom?

Based on the findings from the surveys, implications for training of faculty and suggestions for techniques for taking courses and methodologies online are offered.

Findings

The survey instrument entitled, *Adapting to the Distance Learning Environment*, produced results in three areas: feelings about the distance learning environment, factors which helped make sense of the distance learning environment, and technologies of the distance learning environment. The population for the surveys were all students enrolled in distance learning courses taught by compressed video instructors. Statistically significant results from the surveys were determined using the *chi-square* analysis. Since the responses to the questions on the surveys yielded frequency data, the *chi-square* analysis was appropriate.

Feelings about the DL environment

The first part of the questionnaire asked students to describe their feelings about the distance learning environment on the first day of class and on the last day of class. The factors used in this part of the survey were gathered from the literature related to the conceptual framework for this paper. The responses from the students to the statements in this part of the survey reveals the following results:

First day results. From the responses to the factors, data in Table 1 show that eight factors appear to describe the students' feelings about the distance learning environment on the first day of class when analyzed by gender. Demographics show that 68.6% of the respondents were female, 30.4%, male. Only two of the factors are mentioned by both groups— comfortable and motivated.

Table 1.
How Students Felt on the First Day By Gender

Factor	Semester 1 *p* *n*=290	Semester 2 *p* *n*=345
apprehensive	0.031	n/a
comfortable	0.018	0.052
excited	n/a	0.011
hopeful	n/a	0.045
motivated	0.005	0.065
neutral	n/a	0.045
proud	0.084	n/a
supported	n/a	0.079

Table 2 shows the feelings of the respondents when analyzed by age. Demographics show that the students were represented by the following age groups: 18-25 years of age, 41%; 26-35 years, 33%; 36-45 years, 18%; and 46-54 years, 8%. In this instance, nine factors appear to have significance for the students; however, none of the factors was the same for both groups.

Last day results. Students were asked to denote factors which appear to describe the feelings of the students on the

last day of class in the distance learning environment. Table 3 illustrates that nine factors appear to describe the students' feelings on the last day of class; none of the factors was the same for both groups.

Table 2.
How Students Felt on the First Day By Age

Factor	Semester 1 *p* *n=290*	Semester 2 *p* *n=345*
apprehensive	0.001	n/a
awestruck	0.073	n/a
comfortable	n/a	0.052
curious	0.048	n/a
hopeful	n/a	0.090
lonely	0.048	n/a
motivated	0.048	n/a
recognized	n/a	0.015
surprised	n/a	0.001

Table 3.
How Students Felt on the Last Day By Gender

Factor	Semester 1 *p* *n=290*	Semester 2 *p* *n=345*
apprehensive	n/a	0.013
awestruck	n/a	0.039
curious	n/a	0.036
intimidated	0.044	n/a
isolated	0.053	n/a
lonely	n/a	0.021
overwhelmed	0.019	n/a
proud	0.089	n/a
surprised	n/a	0.002

Table 4 illustrates how students felt on the last day of class when analyzed by age. Table 4 presents the nine factors which describe their feelings on the last day of class. Only one factor—apprehensive—appears in both semesters.

Table 4.
How Students Felt on the Last Day By Age

Factor	Semester 1 *p* *n=290*	Semester 2 *p* *n=345*
apprehensive	0.008	0.054
comfortable	n/a	0.001
fearful	n/a	0.005
intimidated	n/a	0.046
lost	n/a	0.097
motivated	n/a	0.025
neutral	0.001	n/a
overwhelmed	n/a	0.003
recognized	n/a	0.029

Data from these four tables have significant bearing on the training and delivery of instruction in the compressed video classroom.

Factors which helped make sense of the DL environment

When asked in part two of the survey which factors helped them make sense of the distance learning environment, the students responded to a series of 41 statements gathered from LHTL theory and distance learning research. Table 5 exhibits the factors which appear to have helped students cope with making sense of the distance learning classroom when presented by gender. Only one factor—encouraged to participate—was mentioned by students in both semesters. Each of the other nine factors was different for each semester.

Table 5.
How Students Cope with the DL Environment by Gender

Factor	Semester 1 *p* n=290	Semester 2 *p* n=345
Time of course fit schedule	0.056	n/a
On-site support	0.026	n/a
Access to materials	0.025	n/a
Encouraged to participate	0.041	0.025
Motivated to study	0.097	n/a
Participated more	0.047	n/a
Needed more explicit directions	0.082	n/a
Able to monitor own learning	n/a	0.082
No frame of reference	n/a	0.042

Table 6 demonstrates the feelings of students related to adjustment to the DL when analyzed by age. This table shows that seventeen factors appear to have statistical significance. Only two of the factors—on-site support and encouraged to participate—were mentioned by both groups. The other fifteen factors also appear to have vital significance for delivery of instruction via the compressed video environment.

Technologies in the DL classroom

In part three of the survey, questions dealt with the technologies of the distance learning environment. Specifically, students were asked to identify the technologies the *distance learning instructor used* during the course and the technologies *they used* and *mastered* during the course. Additionally, students were asked to identify the technologies they had seen *used outside of the distance learning classroom.*

It appears from the responses by the students that *instructors used* computers (83.1%), the document camera (76.7%), the TV (71.6%), the podium tablet (70.3%), the VCR/Video (65.9%), e-mail (59.8%), and presentation software (52%) in the distance learning environment.

However, the only technology *students used* was the computer (73.6%). To a lesser degree, students used e-mail (47.3%), the Internet/WWW (44.6%), and the TV (43.9%). It is interesting to note that the students used the Internet/WWW more often than the instructors (33.1%, instructors versus 44.6%, students).

Table 6.
How Students Cope with the DL Environment By Age

Factor	Semester 1 *p* n=290	Semester 2 *p* n=345
Interaction of instructor helped me adjust	0.011	n/a
Prior experience	0.083	n/a
On-site support	0.051	0.001
Encouraged to participate	0.085	0.020
Atmosphere conducive to learning	0.058	n/a
Learned name	0.004	n/a
Encouraged to ask questions	0.072	n/a
Able to monitor own learning	0.026	n/a
Encouraged to reflect	0.026	n/a
Motivated to study	0.064	n/a
Goals & aims communicated	n/a	0.083
Distance to travel	n/a	0.001
DL environment fit learning style	n/a	0.070
Convenience	n/a	0.001
Instructor attitudes and skills	n/a	0.014
Location	n/a	0.001
Flexibility of DL	n/a	0.062

When asked which technologies students felt they *mastered* during the distance learning course, students felt that, to some extent, they mastered the computer (32.1%) and e-mail (30.7%). *Outside* of the distance learning classroom, students saw the following technology used: computer (80.1%), the Internet/WWW (66.2%), VCR/Video (65.9%), TV and word processing software (62.2%), and spreadsheet software (57.4%).

Recommendations for Taking Instruction Online

Results from the two iterations of the distance learning survey indicate that the following techniques may prove to be helpful for instructors in the compressed video environment:

1. Instructors must have training which focuses on the apprehensions, fears, and coping mechanisms which students exhibit and apply during the first days in the distance learning environment. Learning students' names, providing explicit directions for completing assignments, encouraging students to use the site facilitators for technology instruction, and encouraging students to participate are only a few of the devices which may prove helpful to students.
2. Instructors must meet certain guidelines for adapting courses to the distance learning environment in their course syllabi. Specifically, introducing students to the technology in the distance learning environment and how it works may allay some students' fears; providing a technology back-up plan when the technology fails is essential; requiring students to *use* the technology in the classroom from the very first day begins to ease students' fears and apprehensions—introducing themselves at the podium by looking into the camera and using email are two critical technologies for the first day; and continuing to require students to use and master the technology will prepare them for the high-tech classroom and workplace. Approval of courses should not be forthcoming until and unless the instructor has proven that adaptation factors and technology factors have been adequately addressed.
3. Instructors also may assist students to make sense of and adapt to the distance learning technology through interaction with peers, being encouraged to participate in discussions, and relying on their own internal motivations to learn independently, to monitor their own learning, to use life experiences, and to employ a high degree of autonomy. These findings support the adult learning and LHTL theories which formed the conceptual framework for the study.
4. Instructors must take the time to employ a wide variety of teaching methods to assist students in the distance learning environment. Small groups, individual presentations, asking questions, classroom discussions, and inter-site group work are possible and successful in the compressed video environment *if* the instructor will take the time to think through the process. Relying on the star configuration in the compressed video environment will not get students involved and excited about their learning.
5. Instructors must learn and introduce new technologies into instruction. Email is becoming a very common way for students to communicate outside of class with instructors—it also provides the opportunity for instructors to extend learning and require students to reflect on in-class exercises and materials. However, other Web-based discussion thread sites are available to instructors. In these discussion thread sites, students can read other students' thoughts and reflect on and respond to the discussions in an appropriate manner. To this end, continuing education for DL instructors is imperative.
6. As students in the DL environment are surveyed about their feelings and coping mechanisms, instructors will need to adjust materials, methods, and technology to continue to meet the needs of students. A certain level

of maturity can be noted in the differences in the responses of the students in this research.

Distance learning holds the promise of overcoming time and distance restraints for learners; for improving course design and delivery techniques; for focusing intense attention on learners' needs; for reflecting on how teachers teach and prepare instruction; and for determining how individuals adapt to new environments. All of these are compelling reasons for learning as much as possible about distance learning as a training delivery system and how all of the participants in the distance learning classroom adapt to the environment.

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Building a Support System for Distance Learning Students

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Student support services are generally the greatest predictor of the success of a distance learning program. Yet at many institutions, student services in distance learning take a backseat to technology purchases, instructor training, staff development, marketing campaigns, and other building blocks of a distance program. Faculty may receive weeks of training, but students simply show up, receive a few handouts and a short talk, and begin class. Sometimes student services are "innocently" underdeveloped because of a lack of funds, inadequate staffing, or time pressures. But without support services, the entire investment in distance learning becomes very fragile. The symptoms of an institution without adequate student support systems in place may include declining or static distance enrollments, disgruntled faculty, apathetic students, inaccurate registration figures, or students who lack basic services such as ID cards, text, or library access until a course is well underway.

The State University of West Georgia (UWG) has the seventh largest graduate teacher education program in the United States. Each year, the number of graduate education students taking courses via distance learning (two-way interactive videoconferencing or on-line) nearly doubles. The top priority for the distance learning department at UWG during 1997 was to develop a comprehensive support system for these students.

Each quarter, distance learning students at UWG are surveyed regarding course satisfaction. Although the survey's Likert-scale questions are directed towards teaching and technology issues, the survey also includes an open-ended portion where students can discuss what they like most and least about the course. In many instances, students in past years complained about not receiving materials timely, communicating with the university, and receiving knowledge about schedules, financial aid, and upcoming courses.

Components of Support

As a first step, the distance learning department developed a 10-minute video to acquaint students with the technology and to provide success tips. The video is shown to all distance learning students during the first class meeting, and features footage from actual distance courses to demonstrate proper classroom protocol. Although the video helped students to prepare themselves for the responsibilities of distance learning, they still complained that they had no single reference point from which to obtain help.

Thus, the next step was to write a comprehensive handbook for all students and develop a web site. At a minimum, students were to have information regarding registration, financial aid, parking, library access, names and phone numbers of contact persons, calendars of university deadlines, a guide to technical issues, course information, and advisement procedures. In addition, the handbook and the webpage included a section for frequently-asked questions (FAQs), that sought to provide students with empathy and understanding concerning frustrations they might encounter. Future plans for the web site include an interactive introduction to distance learning for students.

The third prong of the UWG student support system became a telephone help-line. Students can make one call to get receive assistance on any administrative or technical problem they have. Thus far, most questions received have been inquiries regarding upcoming distance courses. Surprisingly, students have thus far needed less technical assistance than anticipated. Although the phone is presently staffed only during regular business hours, future plans are for extended hours.

Finally, all distance courses are assigned a student assistant who serves to relieve administrative responsibilities of the instructor, provide technical support, and serve as an additional contact person for students. If an on-line student has been inactive for several days, the student assistant may contact him or her by phone or e-mail to see if assistance is needed.

Evaluation

At the end of Fall quarter 1997, a sample of distance students were invited to participate in a focus group, where they were asked if they believed their needs were being met. They were also asked if they had suggestions about further steps the institution should take to prepare them for the distance learning experience. Most students said the presence of a telephone help-line made them feel more secure as distance students, whether or not they actually used the service. There were no substantial suggestions for improvement in terms of student support, although this may be due in part to the fact that most students were new to distance learning, and had not been involved long enough to encounter administrative problems or issues. A follow up focus group is planned for Spring and Summer quarters.

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Distance Learning Models for In-Service and Pre-Service Education

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Distance learning is emerging as a critical opportunity and challenge for institutions of higher education throughout the United States and the world. With growing pressure to provide distance learning opportunities, many institutions of higher education are rushing to put courses and programs into place. But, what sorts of distance learning experiences are appropriate? What delivery systems will best meet students' needs in a particular situation? These are fundamental instructional design questions that are best answered by applying a systematic approach that takes into account the subject matter and students' needs. This paper focuses on models of distance learning that emerge from application of systematic instructional design concepts to instructional problems. Examples of distance learning for in-service and pre-service teacher education, taken from the authors' own experiences, are highlighted.

Today, we are experiencing a boom in distance learning. The traditional college student population pool is beginning to decline, but opportunities for reaching non-traditional students are expanding. As a result, universities are pursuing distance education with increased vigor. The U.S. Department of Education (1997) recently released a survey of distance education college courses. According to the survey, in the fall of 1995 a third of all higher education institutions in the U.S. offered distance education courses, led by 62% of public four-year institutions. A total of over 25,000 distance education courses were offered in the 1994-95 academic year reaching over three-quarters of a million students; 45% of that total was offered by public four-year institutions. The most popular delivery methods reported were two-way interactive video (57%) and one-way video (52%). However, one-way video with two-way audio and the Internet were each reported by about a quarter of reporting institutions. While attesting to the growing popularity of distance learning, this survey almost certainly fails to capture the full extent of current efforts because, for example, of the rapid growth of the World Wide Web and delivery of Web-based distance learning in just the past two years.

Because of the pressure to provide distance learning opportunities, institutions of higher education are rushing to put courses and programs into place. Our institution, Purdue University, is no exception. Although Purdue has a long history of distance learning initiatives, a new Office of Distance Learning was created just within the past year, and there are many efforts underway to develop new distance education courses and programs across the campus. But, what sorts of distance learning experiences are appropriate? What delivery systems will best meet students' needs in particular situations?

Planners of distance education must consider the choice of media and methods in light of the potential impact on student attrition, the quality of the experience, its educational status, and cost (Keegan, 1990). Fundamentally, questions about appropriate distance education approaches and methods are questions of instructional design. These fundamental instructional design questions are best answered by applying a systematic approach to the development of instruction that takes into account the nature of the subject matter and needs of the learners (Cyrs, 1997; Dick & Carey, 1990; Newby, Stepich, Lehman, & Russell, 1996). While there seems to be a tendency today for people to jump on the bandwagon of whatever is the latest technology, a systematic approach to instructional design calls for matching media and methods to the needs of a given situation and group of learners. By asking basic questions at the outset, it is possible to identify appropriate models of distance learning that fit the situation.

Applying Instructional Design to Distance Learning

When taking a systematic approach to the design and development of instruction, one can view the instructional process as a set of interrelated components. On a simple level, these components form a PIE model — planning, implementing, and evaluating (Newby, et al., 1996). Planning focuses on designing instructional materials and learning experiences to meet the specific needs of the learners, the content, and the context. Implementing puts into practice the plan to help the learners achieve their

learning objectives. Evaluating involves assessing the level of learning achieved by the learners and/or the effectiveness of the instruction.

Let us focus in particular on the planning component of this process because, with appropriate planning, many missteps can be avoided. Dick and Carey (1990) elaborate that the initial planning steps of the process should include: identifying an instructional goal, analyzing the type of learning required of the learners, and analyzing the characteristics of the learners. These planning steps can be addressed by asking:

- What is the overall instructional aim?
- Who are the learners and, in the case of distance education, where are they located?
- What sorts of learning experiences should the learners have?

By answering these three questions, many of the important issues in planning for distance education can be resolved. For example, if the overall instructional goal is the transmission of basic information, any of a variety of relatively simple media (e.g., print-based correspondence material, videotapes, the World Wide Web) might work just fine. However, more complex aims would likely lead to a need for more complex and interactive distance learning technologies.

Likewise, the nature of the learners and their locations has a significant impact on the planning process. Novices in the use of computer, for example, are likely to be poor subjects for a Web course. We learned this the hard way when, some years ago, we made our first attempt at using computer-mediated communication (CMC) for delivery of an introductory computer class to inexperienced in-service educators. While ultimately fairly successful (Cheng, Lehman, & Armstrong, 1991), the course was fraught with difficulties because the inexperienced users were not able to use the computer network effectively. The medium must be able to reach the learners where they are located, and it should match the characteristics of the learners.

Finally, it is very important to consider what learning experiences you want the learners to have. In face-to-face instruction, nearly the entire repertoire of instructional strategies is available to the teacher. You can make presentations, perform demonstrations, or have class discussions. Students can work with computer software or view videotapes. Students can be teamed to work cooperatively, and so on. At a distance, some strategies are almost always constrained by the limits of the technology. So, it is important to ask, which are the most critical learning activities? If demonstration is a crucial element of the learning process, as it might be in a woodworking class, then the distance learning medium must support that; videotapes or live video might satisfy such a requirement. If discussion is a key element of the learning experience, then having appropriate tools for communication becomes an overriding consideration of the distance learning system.

Models of In-Service Distance Learning

Let's examine how consideration of these basic instructional design questions has led to different models of distance education at our university.

Northwest Doctoral Cohort Program

Launched in 1995, the Northwest Doctoral Cohort Program is a special graduate program in educational administration. (See: http://www.soe.purdue.edu/cohort/home.html.) Let's examine the three key questions and how they were answered for this program.

What is the overall instructional aim? Broadly stated, the aim of the program is to help school administrators simultaneously become certified for a school superintendent's license in the state of Indiana and obtain a Ph.D. degree.

Who are the learners and where are they located? The learners in this program are individuals seeking to become school superintendents. In most cases, these individuals are already school administrators, e.g., building principals, assistant superintendents. The greatest concentrations of school administrators can be found where there are the greatest concentrations of schools and people. In our state, that means the Indianapolis metropolitan area or northwest Indiana near Chicago. Both sites are distant from the Purdue University main campus.

What sorts of learning experiences should the learners have? At the advanced level, educational administration is largely an issues oriented field of study. While there is content (e.g., school law, finance), much of the curriculum deals with issues of leadership and the problems of managing the large educational enterprise of a school district. As a result, it is important for the learners to see examples of a variety of problems and issues, grapple with them, and come to appreciate new perspectives on them through discussion and reflection.

So, what does this tell us about the nature of this program? In this case, several factors together affected the decision to structure this distance learning experience in the way that it now exists. Because of the concentration of potential students, the decision was made to begin the program in northwest Indiana. This decision was supported by the fact that Purdue University's Calumet regional campus is located in the area. Because the Calumet campus is not authorized to grant Ph.D.'s in educational administration, a distance learning program was conceived. But, what sort of program would it be?

School administrators are busy individuals. Because of the distance to the Purdue University main campus, travel to the main campus was out of the question. So, the decision was made to offer classes early in the evenings at the regional campus. Because of the need for these

individuals to grapple with issues and see a variety of perspectives, a cohort program was devised. Participants move through the program as a group, and the individuals become resources for each other. Further, in order to permit a high level of dialog and discussion in classes, two-way interactive video is used to deliver the courses to the regional campus. As a result, the instructor on the main campus and the members of the cohort group on the regional campus can discuss issues and present materials as if they were all together in the same room.

This example illustrates how consideration of the basic instructional issues can lead to a decision to structure distance learning in a particular way. In this case, the model is composed of a coordinated sequence of courses, delivered from the main campus to a regional campus by means of two-way interactive video. In the last year, the program expanded to include a site in the Indianapolis area so that it now reaches both major population centers in the state.

Topics in Educational Restructuring

Other programs offered via distance learning have relied upon other approaches. Beginning in 1993, one of the authors has taught a graduate level course EDCI/EDFA 591, Topics in Educational Restructuring. (See: http://www.soe.purdue.edu/~lehman/edci591/intro591.htm). Let's examine how the answers to the basic questions compare in this example.

What is the overall instructional aim? The aim of this course is to give interested individuals the opportunity to learn more about the many issues and concepts involved educational reform and restructuring.

Who are the learners and where are they located? Unlike the Doctoral Cohort Program, the learners in this course can be quite diverse. Individuals interested in course topics often include: school administrators, in-service teachers, curriculum coordinators, college faculty, and education graduate students. Students can have varying backgrounds, abilities, and schedules. They can be located almost anywhere from on campus to schools within the state to more far-flung locales.

What sorts of learning experiences should the learners have? The issues surrounding educational reform are complex and intertwined. To give students an opportunity to come to grips with the concepts and issues, they need to read current literature in the field and interact with others to encounter multiple perspectives. What is needed is something like an on-campus seminar but at a distance.

Given these considerations, what is the nature of this distance learning model? In this case, the factors that influenced course design included: participants' schedules and locales, course content, and the need to approach topics from a variety of viewpoints and in depth. The methodology that was chosen was computer-mediated communication (CMC). CMC has been touted as an excellent medium to promote meaning making in distance education (Jonassen, Davidson, Collins, Campbell, & Haag, 1995).

CMC provides a mechanism for extended dialog on topics. With it, we could reach participants who had access to a computer and a modem almost anywhere. When we first began the course, we used a computer network called IDEAnet that was available to any educator in Indiana through toll free dial-up access (Lehman, McInerney, & White, 1993). We purposely chose to use the "lowest common denominator" technologies — mainly e-mail — because, when we first started, 2400 baud modems were the norm. Readings were initially supplied as a print packet that was mailed to participants. As the Internet matured, the course matured and changed with it. As a result, in a recent offerings, we have had participants from as far away as Norway, and we have been able to rely on readings available on the Web rather than printed copies of articles. A Web site now supports the course, although the heart of the course, the on-line discussion, still takes place through e-mail. For our educational goals, the discussion remains our primary vehicle for learning.

These examples illustrate how different distance learning solutions may emerge when basic instructional design issues are considered at the outset. By applying systematic approaches to the selection of media and methods, we can arrive at appropriate solutions for particular situations. While these examples have addressed in-service education, we have extended the concepts to pre-service education as well.

Applications to Pre-Service Teacher Education

We can examine our pre-service teacher initiatives by first looking at the same basic instructional design questions. What is the overall instructional aim? Distance learning is clearly rise in K-12 education as well as higher education. Therefore, our basic aim in these initiatives is to give our teacher education majors exposure to and experience with common distance education methodologies. Who are the learners and where are they located? Our students in these initiatives are on-campus teacher education majors. What sorts of learning experiences should the learners have? At a minimum, we want them to experience distance education methodologies as learners. If possible, we want them to also leave our program having had some experience teaching at a distance.

Several projects are underway. With the success of e-mail and the World Wide Web, a number of our on-campus courses now make use of e-mail discussions to extend dialog beyond the confines of the class period. In another project, education students at Purdue use electronic mail and UNIX chat to tutor students in a community about two hours from the Purdue campus. In addition, one of the classes in the Northwest Doctoral Cohort Program enrolls undergraduate students who are pursuing a computer

teaching endorsement on the main campus. This gives these students first hand experience with the two-way interactive video. Therefore, students have opportunities to experience a variety of distance learning environments.

The most extensive pre-service teacher experience in distance learning takes place in EDCI 260, Introduction to Computers in Education. This course is an undergraduate elective (soon to be required) in educational technology with an enrollment of about 150-250 students per year. During the 1996-97 academic year, a major initiative was launched with funding acquired by school-based colleagues Kathleen Steele and Dawn Colavita in the Crawfordsville Schools, Crawfordsville, Indiana, a community about 45 minutes south of the Purdue main campus. In Indiana, many K-12 schools have two-way interactive video distance education capability through Project Athena, a statewide initiative supported by equipment grants from Ameritech. The Crawfordsville Schools have the nearest Project Athena site to Purdue. They worked with Purdue to initiate this project as a way to begin exploring their own use of this capability.

At the outset of the activity, students in each of the EDCI 260 course laboratory sections experience distance learning via the two-way interactive video as learners. Students come to Purdue's Ameritech Distance Learning classroom, a facility located in the Liberal Arts and Education Building and supported by PictureTel digital video equipment and ISDN telephone lines. There they are treated to a program by one of the education content providers available through the Project Athena network. These content providers include the Indianapolis Children's Museum and the Indianapolis Zoo.

After experiencing the distance learning environment as learners, teams of students are assigned to work with a cooperating teacher in the Crawfordsville Schools. Through the interactive video equipment, the students conduct a conference with the teacher to plan a lesson for the teacher's high school class. The students then spend about two weeks to prepare a lesson off line. Finally, on a pre-scheduled date, the student team meets with the Crawfordsville class online and conducts a short distance education lesson. Thus, the students are able to leave the course having not only experienced distance learning as learners but also have planned, implemented, and evaluated a distance learning lesson.

Conclusion

When basic instructional design issues (goals, nature of the subject matter, and needs of the learner) are taken into consideration, different distance learning models may emerge as appropriate for different learning situations. No one method is correct or best. Rather, by applying systematic approaches to the selection of media and methods, we can arrive at appropriate solutions for particular needs. With careful selection, effective distance learning experiences can be constructed for both in-service and pre-service teachers.

Of course, evaluation must be an on-going part of these programs. After a couple of years of experience, for example, we have determined that two-way interactive video may not be necessary for every class in our Northwest Doctoral Program. The rich, reflective dialog which can come from CMC may suit our aims as well or better and at much less cost. So, we are looking to make adjustments. Some of the dialog in the cohort classes will be shifted to CMC while we will use the video for what it does best, allowing for presentations and face-to-face interaction. With clear thinking and a systematic approach, we can continue to take advantage of the exciting opportunities that distance learning provides.

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Integrating Computer Technologies in Distance Learning as Part of Teacher Preparation and Inservice: Guidelines for Success

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Since Wyoming is sparsely populated with communities separated by large distances, distance learning and commu nication systems are in great demand. The delivery of teacher inservice especially, requires the use of distance learning technologies. It is not uncommon to respond to inservice needs that include a small group of twenty or fewer teachers spread over 300 miles apart with as few as two-three persons per site. Practicum sites for undergraduates are sparsely distributed throughout the state as well. Conventional delivery systems, face-to-face inservice courses and on-site supervision of undergraduate practica, are becoming increasingly difficult to justify because of the time commitment required for travel. In addition, people in a globally based economy will find it necessary to use computer mediated technologies to access information and communicate with others (SCANS, 1991).

Distance delivery requires extra effort to insure that students' basic information needs are met and that as more complex computer technologies are introduced, a stronger support system for solving problems is needed. Incorporating the use of the Internet, course web pages, and computerized "chat rooms" adds a complex set of problems that can overwhelm some students. Problems can and likely will arise which, if appropriate support systems are not in place, will negate learning.

The purpose of this paper is to introduce guidelines that can contribute to the successful delivery of distance instruction to teachers using a variety of delivery technologies. These guidelines have evolved from extensive experience in teaching and administration of distance delivered courses, student evaluations, research studies conducted upon previous courses, and from the literature. Factors that seem to make a difference in the quality of distance instruction have to do with planning, instructional design and management, facility and support for teacher-student and student-student interaction, reliable technical support, empathy for student needs, and instructor training (Willis, 1993). The interesting finding is that these factors are the very same ones that are essential for success of a conventional face-to face delivered course (McKeachie, 1986).

Guidelines

We have organized these guidelines under the following categories: course design, general delivery strategies, computer strategies for delivery, student and administrative considerations, and evaluation. Within each category the guidelines are offered not as an exhaustive recommendations, but rather as examples of considerations or techniques intended to make a distance delivery experience more successful.

Course Design

A systematic method of planning developing, managing and evaluating the instructional process is basic to effective and efficient distance education, or any instruction for that matter (Kemp, Morrison, & Ross, 1998). But what should be included in thinking about such a systematic development of instruction? The traditional umbrella categories of analysis of the learning situation and the learner, delivery strategies, and evaluation must of course be considered, but three specific areas that should be considered for good distance delivery of instruction are suggested below.

The course design should help resolve the balance between formal structure and interactive dialogue. Including more dialogue can develop more interaction and community. Doing this has resulted in evaluation comments that were very positive from some students. Such comments usually remarked on the opportunity to "see a topic through its course," or "understanding another's position with greater clarity." Using lots of dialogue can result in negative comments however. For example, students sometimes remark on "time wasted in unrelated topics." This tension between time on task and time devoted to student interaction and community must be

addressed to provide both dialogue and structure in appropriate amounts.

The course design should be attentive to developing a learning community. Many hours can be devoted to designing course content and massaging subject manner, but equal time should be given to developing a learner-centered course that allows learners to build a support community within the class. Success in distance instruction is positively correlated with a sense of ownership and community among the students. Distance students at remote sites who have neither often drop out of courses and programs. Building community and ownership requires the use of learning strategies that are flexible and adaptive and the use of delivery strategies that incorporate interaction and dialogue.

The course design should identify goals, instructional processes and distance delivery procedures. Separation tends to heighten students concern regarding what is expected of them, so it is essential to provide learning structures such as a detailed syllabus that includes a course calendar, clear goals and objectives, assignments, grading policies, deadlines, and other expectations. Determine specifically activities such as registration and collection of fees, distribution of class materials, receipt of student papers, use of copyrighted multimedia and print materials, responsibilities such as grading, and other protocols and procedures the educational organization may require (Rezabek, Cochenour, Bruce and Shade, 1994). It is also very useful to determine the optimum conditions for instruction. Such considerations include: class size, number of sites, number and length of class sessions, variety of delivery modes, and other issues related to the course.

General Delivery Strategies

Preplanning Group Sessions. When planning group sessions, it is important to communicate the process as well as the topic/issues that will be addressed. Prior planning includes such items as developing a list of discussion questions or readings for reaction that can be sent to participants by email or posted on a web site. Another strategy is to create a scenario or case study for reaction. Sometimes, a videotape or satellite broadcast is available as a discussion item. A course web site can also be used to post a multi-media slide presentation produced by the instructor.

In planning and communicating distance delivery technology procedures, it is essential to increase the time interval before sessions actually occur. One convenient strategy is to send an email to all participants several days prior to the next group session with reminders of assignments, readings, or other key information to prepare for the session. Announcements, tips, or supplementary information can be communicated in this way to encourage consistent use of the technology.

Promote interaction and collaboration. We require at least three students per remote site and encourage these students to work together and develop a small learning community that can rely on each other for support throughout a course or program of study. Peer learning can support both the novice and experienced distance learner. These groupings often promote students to select learning projects of local interest, thus increasing the relevance and real-world applicability.

Another way to promote interaction is to restrict the use of lectures. Ten minutes of lecture over a distance delivery system appears to be the maximum time for a didactic presentation. Instead of more lecture time, we would suggest a variety of instructional options be incorporated. These options are viewing and listening (such as in lectures), writing, and speaking. Writing strategies would normally include the use of an interactive study guide, specifically posed questions or learning journals.

Speaking strategies could include discussions, presentations, and role playing.

Discussions can be held among all class members or among sub-groups established for that purpose. Sub-groups can be at a particular site, or from members assigned from specific sites. Regardless, sub-group discussions should be followed by a return to the class as a whole for summarization and further discussion. Discussion strategies require sufficient time to satisfactorily complete the discussion, which means a limitation to one or two specific issues. Individual and/or group presentations and projects are quite feasible in distance delivery situations. However, the course design should have a portion of class time built in for students to practice their delivery skills where feasible. As with discussions, role playing can occur within a site or across sites. Case studies, scenarios, and videotapes are effective starters for a role play. Again, planning and time controls are essential for successful role plays, and often instructors need to be proactive in getting role plays started. For example the instructor might need to ask someone from a specific site to take part, "I'd like someone from Casper to be a risk taker today and to take part in creating a scenario with me. We'll role play a situation to start a class unit on conflict mediation" (Rezabek, Cochenour, Bruce and Shade, 1994).

Group projects and presentations promote collaboration and can build a learning community. We have experienced students developing a group identity simply by having common experience in successfully overcoming the limitations of distance technologies. To encourage this process students should have opportunities to work directly with the delivery technology and to help one another with the mastering of each of the methods used in a course to connect students and instructor. Connecting and collaborating with peers in the distance education environment encourages student persistence, celebrates new learning,

and provides constructive feedback (Burge, 1994). Also, several students noted an increase in self confidence resulting from communication with people at different locations who acknowledged their ideas.

An important practice to follow is to design assignments that are practical and have application to the students' experiences. These activities should be designed for "think it through" level that have a reasonable time frame for completion. Also, it is important to provide time for students to share their work with each other for interaction. The assignments should be designed for reflectivity to allow a vehicle to express honest thoughts or concerns about the topics, issues, or any aspect of the course delivery.

Facilitate with spontaneity, balance, and humor. One student commented, "I really had to plan my responses and be ready for a pause in the discussion, so I could break in with my answer." This comment demonstrates the potential difficulty in facilitating spontaneous interaction at a distance, and hot topic discussions can become competitive. An instructor needs to periodically break into the conversation, if necessary, to widen the group by restating questions and responses or offering feedback before directing the discussion to another site or person.

It is very important to balance participation among the remote sites. Instructors should not show favoritism to any particular site or person, nor should any site or person be allowed to monopolize discussion. Without sufficient thought and preparation, it can be difficult to balance the participation among all sites. Another aspect of balance and participation is the tendency for students to conduct side discussions. As one student remarked, "Our group had to be made to talk with the entire class. Most of the time we tended to talk among ourselves at our site." Many learners need to participate and respond in order to feel a class session is a fruitful one. Side discussions can be acknowledged by incorporating local discussion time, and by insuring that each site has an opportunity to share during large group sessions.

The appropriate use of humor and self-revelation can be employed to create trust among participants and to humanize the distance environment. The use of appropriate humor can assist in establishing a warm, receptive learning environment. It can also enhance the climate for creativity, risk taking, and brainstorming; and can reduce anxiety at each site (Rezabek, Cochenour, Bruce, Shade, 1994).

Use questioning techniques that force learners to be actively engaged. Call on students by name and rotate questions among sites and students so everyone can expect a reasonable chance to contribute. Another technique is to use a random number approach to call on participants for response. Ask students to introduce themselves by name when they respond. Don't be afraid to wait after asking a question; give students a chance to think about the question and position themselves to use the telecommunications technology. Check occasionally to see if everyone can hear or see. Students are notorious for not identifying technical problems until after class is over, so encourage them to speak up rather than accepting poor quality transmissions

Computer Technology Strategies for Delivery

A wide range of computer technologies can enhance the distance delivery of an inservice course or aid in communication with a practicum student. An effective way to communicate with a group or an individual is through use of email. The technology is fairly user-friendly now and most people have access to a computer and modem hardware. A group mailing list or listserve is fairly easy to establish. Email provides an effective way to interact among participants and the instructor. Reflective journals, responses to discussion questions, submission of assignments, and issues of concern can be communicated effectively. Email software is now available which makes the management of group mailing lists, and archival of documents simple to handle.

The Internet has probably caused the most excitement related to distance technology in recent years. Several strategies may be used to facilitate distance delivery of information. Web sites can provide a convenient way to distribute essential course information, class schedules, assignments, reading lists, and supplementary materials. Simultaneous web conferencing provides a powerful strategy for conducting discussion groups and reporting of professional experiences that can be interactive for all participants. Also, several multi-media applications make it possible to create visual presentations that can be posted to a web site. Participants in an inservice course can download and view the material as often as they wish. When used in conjunction with either email or a web conference, the communication can become interactive as well.

Another strategy that works well is to encourage the use of the Internet as a tool for information searching. However, the random way in which information may be posted on the Internet frequently causes problems with locating quality information desired for a topic. By designing assignments that provide guidelines and hints for conducting keyword searches, the chances for successful information retrieval is enhanced.

Student and Administrative Support

One of the most important set of guidelines learned for distance delivered activities relates to student support. Without extra effort in this arena, frustration levels peaked so quickly that negative impact on learning quickly became dominant. Technical assistance, cheerful "customer service", and non-threatening problem solving services are essential. Technical assistance before, during,

and after sessions is a must for success. Conventional communications systems need to be available as a backup for support to aid the participant in solving problems. For example, access to friendly assistance through a toll-free telephone number, and ability to talk to a "real person", is probably the most effective way to reduce frustration levels. The administration and support service personnel must realize that a facilitative and forgiving atmosphere must be maintained at all times. It is essential that the participant is led to feel that the institution cares about the individual being successful in the distance delivery of the program.

A shared responsibility for technical assistance should be accepted by the administration and the instructor. The administration includes clerical personnel, technicians, and administrators of the program. Anyone who may have contact with the student must assist with a facilitative and forgiving atmosphere and project the "customer service" orientation at all times. Assumptions about the expectations of students' technical expertise and responsibilities should be minimized. Quick feedback with problem solutions is essential. An atmosphere of willingness to coach participants through problems and repeat as many times as necessary must be adopted by all administrative, clerical, and technical support personnel. It is important to make follow-up contacts to determine any particular problems hat may have occurred rather than wait to hear from a frustrated customer.

In spite of all the best planning and technical support, problems will arise that cause frustration. The instructor must be prepared for these events and maintain a sense of humor and exhibit empathy for the participants. Alternative communication backup systems must be in place when these problems arise. Contingency plans must be communicated in advance to prevent high levels of frustration and fear from occurring. Clerical staff as well as instructors must be willing to fall back on conventional methods such as telephone and mail to communicate essential course information and technical assistance. At times, detailed step-by-step procedures are needed to insure success.

Additional effort is required to prepare for a distance-delivered activity. Clerical support is needed to send mailings and make personal telephone calls to insure that everyone is prepared and properly coached to join the activity. Adequate lead-time is needed to mail course packets and technical instructions to participants. Sometimes, practice sessions with the particular technology are needed to insure success for everyone. If possible, local technical support should be arranged to facilitate delivery.

Instructors should be accessible to students. There are a number of ways to accomplish this, but one method that has been successful for us is electronic office hours. These office hours are accomplished through a variety of approaches. First, the use of email and published email addresses allows students to access instructors 24 hours a day. This should be qualified by clear standards regarding the instructor's schedule, workload, and turnaround time for reading and replying to email. Don't raise student expectations above the reality of an instructor's ability to respond. Second, post office hours during which an instructor will be available by telephone to distance students only. Distance students deserve a period of time each week when communication between student and instructor can occur. Third, have a fax number that students can use to send materials to an instructor. Other communication aids such as 1-800 numbers, answering machines, voice mail, willing secretaries, and a policy of promptly responding to student needs can assist in accessibility and student satisfaction.

Class size and electronic delivery sites should be of a reasonable number. Our opinion is that student to instructor ratio should be no higher than 25 to 1. This derives from constraints created by student email and the need to facilitate a class in a pro-active manner. We have also found the optimum number of sites in an audio or video teleconference to hover around seven. We have experienced as few as one and as many as fourteen, but instructor's ability to effectively manage an interactive and collaborative class becomes severely taxed as these numbers grow. Also, issues of system operations, remote sites and facilities, and other infrastructure items can limit numbers.

Evaluation

This is a critical element in the effective delivery of distance education. No course in which we have been involved has ever approached perfection. In order to learn from a specific experience, feedback from those involved is critical. We recommend two formative evaluations, a formal one conducted at the mid-point of a course and a number of informal evaluations done at the conclusion of each class. If a few minutes at the end of each session are given up for informal formative evaluations, immediate feedback can assist in making changes in approach or content before following sessions. We also conduct the usual end-of-course summative evaluations, but it is important to seek feedback to specific concerns and questions. Students are also encouraged to respond to difficulties and problems by providing immediate feedback to the instructor or to the responsible administrative unit.

Formative evaluation during course delivery and after-course summative evaluations have played a part in the development of the guidelines suggested here. When asked whether they preferred face-to-face instruction or distance delivery, our students have been roughly divided into thirds. One-third preferred the face-to-face, one third preferred the distance delivery option, and one-third indicated that using both methods would be their preference. This result is perhaps tempered by the recognition that face-to-face instruction is not a true option for many of

the students, however our students have indicated a high comfort level with the distance technologies. Most of them have been overwhelmingly positive about their experiences in distance education (one of our graduate students is working on her Ph.D. at a distance and has received both her B. A. and M. A. at a distance). As one student commented, "Öthe good points pretty much compensate the bad."

Conclusions

We shouldn't assume that computer literate students do not need training and support to effectively use distance learning technologies. Developing an attitude of openness to new education technologies is an important step for everyone. Distance delivery problems require the presence of backup systems and an instructor with a proper frame of reference, i.e., a sense of humor, and skills in managing stress.

A majority of our students, indicate that they believe distance technology is an important, if not essential, educational tool and resource. Many have spontaneously generated ideas for further use of the distance delivery during their education. These suggestions include talking with teachers and students in other states and nations; mentoring student teachers in the field; conducting job interviews and/or admissions interviews; and other conferences.

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So You Want to Develop Web-based Instruction — Points to Ponder

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Web-based instruction (WBI) is at the cutting-edge (sometimes called bleeding-edge) of both today's technology and instructional design methodology. It offers significant opportunities — opening up education to the unserved or underserved, providing new tools to enhance learning, and increasing convenience for learners in terms of effective use of place and time.

But before beginning any discussion of WBI, it is imperative that the underlying motivation for beginning this discussion be explored. Instructional leaders must resolve the "Why do we want to do this?" issue before moving on. The answer will drive your response to many related issues. Possible answers to this key question include to:

- provide more convenient access to education.
- serve a previously unserved/underserved population.
- protect your share of the instructional market.
- expand your share of the instructional market.
- become a national leader in WBI.

Presuming that the institution successfully resolves the answer to the preceding complex question and decides to proceed with this project, we see the need for action focused on institutional commitment, instructional design and development, and student issues.

Institutional Commitment

Commitment is the place to begin. WBI must be intentional and purposeful. Campus-wide systematic planning is of the utmost importance to this endeavor. To successfully implement this type of a program, an institution should make a significant, long-term commitment concerning co-involvement of institutional units, resources, and faculty reward structure.

Co-Involvement of Institutional Units

The institution must develop partnerships within its existing units because each possess the expertise and resources that may never exist within individual co-operating units. The administration from the President on down must support this project, because without their support, the inter-unit partnerships that are required to enable program success may never develop. An institution-wide leader must be appointed who has not only the expertise to complete the project, but also the power to make it happen (Shore, 1997). Specific organizations that will greatly impact this process are the computer center, organic centers for instructional design and development, student services, and programs which contain content expertise.

Resources

Critical resources may be grouped into two general classes, personnel and technology. Personnel will be needed to develop and manage the WBI. Development requires specialized training and expertise which is slowly acquired. Initially only a handful of faculty and staff may have the necessary skill sets. Of course, outside hires or consultants are possible solutions, but this still requires resource commitment. The commitment doesn't stop once the WBI is developed, though. It continues throughout the life of the course, a much longer time than the development period.

One of the major resource areas that must be explored prior to beginning instructional development of web-based courses is the technology. Problems including service volume, compatibility, training, and technical support must be solved before one can begin to successfully develop web-based courses.

WBI, by design, will significantly increase the load on the institution's web distribution capability. Planning must be accomplished for this increased traffic to preclude total gridlock when students of WBI courses are trying to access information. Problems including incompatibility between

student and instructional hardware and software systems and slow internet connections must be taken into consideration when developing web-based courses. Faculty and staff who are developing the courses need access to computers and software that are capable of handling the various tasks necessary to develop the multimedia elements required to support a web-based course. These elements include, but are not limited to video, sound, and graphics.

At the other end of the spectrum, students will need a system and software to display all the components of the courseware. Courses will need to be developed in such a way that they can be delivered regardless of what system is available to the student. The software necessary to run various parts of the courseware must be made available for the student to download either on- or off-site. Bandwidth also becomes a problem. An uncompressed one hour movie running at 30 fps at a resolution of 640x480 requires 100 GB to store. Time to transmit using a 28.8 kbps modem is 320 days (Fryer, 1997). These problems make hybrid designs (combinations of CD and WBI) attractive.

Another problem area is training in the capabilities and limitations of the web and its use by both the faculty who are developing the courses and the students who will be expected to take the courses. Most faculty do not possess the technical skills necessary to develop courses for delivery over the web. This is currently mitigated by the fact that instructors who are developing on-line courses at this time have some knowledge and interest in computers. Students will need to acquire the necessary skills to configure their system to run the WBI courses. Once the courseware is developed, hardware and software for distribution is necessary.

Technical support becomes critical as faculty with little or no technical training become involved in developing courses for delivery over the web. As this type of instruction becomes more commonplace, one can expect more involvement from faculty with less computer knowledge. "Those involved in on-line learning initiatives report that robust technical support is crucial to the success of courses." (ed tech, 1997)

Faculty Reward Structure

Faculty commitment to delivering a WBI program is at the heart of any program's ultimate success or failure. They must feel that it is a valued enterprise through the existing reward structure, with significant credit toward promotion/tenure. Faculty productivity, as measured by usual standards, may be severely impacted, posing a risk, especially to non-tenured faculty and faculty below the rank of Professor.

It appears that in many institutions the faculty reward system fails to address critical issues associated with using technology for teaching and learning, and in some cases, actually seems to discourage innovation in technology-based instructional delivery through disincentives. Cummings (1995, 1996) refers to these as faculty resistance barriers, and notes that "when teachers express the belief that for them, implementing ET [educational technology] offers more risks than rewards, their resistance is easy to understand" (1995, p. 14). In considering the design and delivery of web-based courses, some of the key questions related to these issues include:

- Will all faculty be required to design and deliver web-based courses?
- What effect will this time and energy commitment have on promotion and tenure?
- How does the concept of course load change with the use of the web for instructional delivery?
- Will faculty be offered any rewards (monetary or otherwise) for course design and delivery?
- What kinds of training will faculty be given in terms of the technology utilized for WBI delivery?
- Will instructional design training also be provided or will the institution provide instructional designers to work with faculty?
- What other resources will be available to faculty as they work through this process?

In terms of traditional faculty rewards and incentives (additional monetary compensation, reduced course load, etc.) it is somewhat difficult to make general predictions about the relationship between these extrinsic motivators and faculty willingness to participate in the design and delivery of a web-based program. These are, however, internal issues that the institution itself has a high degree of control over and thus are issues that can and should be addressed from the beginning of the planning process. (Connick, 1996)

Instructional Design and Development

The key to success for any learning environment is the effectiveness of the instruction. WBI is presented in a format that differs significantly from traditional instruction. To maximize the learning opportunities for this presentation format requires a shift in pedagogy. WBI alters not only the method in which information is presented to the learner but also changes the way in which the learner interacts with information. The essence of this shift focuses on instruction within the constructivist paradigm. Rather than designing instruction that is intended to deliver information to the learner, it is necessary to design instruction which engages the learner in interactive activities (Sherry, 1995). Careful planning is required to establish that learning is a process in which the student actively participates.

The amount of time and effort that must go into the design and delivery for web-based courses should not be underestimated. Overviews of the major components of this process have been discussed by Odasz (1994) and in *Learning on the Web: An Instructor's Manual* <http://

teleeducation.nb.ca/lotw/>. Each facet requires specialized expertise to produce effective instruction. The initial phase of course design would include a team organized to conduct a needs analysis. Academic units need to determine if existing courses and course sequences are suited for on-line offering, if existing programs could be modified, or whether new programs are more appropriate. Content experts, instructional designers, end-users or practitioners, graphic designers, web page designers, program administrators, and university administrators all need to be included in various phases of the design process. The British Open University has been involved in distance education for over 30 years. Each course offered by BOU is designed by a team of experts which may include as many as 20 or more individuals (Moore and Kearsley, 1996).

Media should always be selected on the basis of the effectiveness of the medium to deliver the content. An initial planning decision involves the appropriateness of WBI for course content. The design team must determine that the instruction can be effectively delivered via computer capabilities. An analysis of course content must be conducted to determine course topics that require other or additional delivery methods. WBI tends to be heavily text dependent. There are many other media including audio, video, photographs, graphics, and charts that can be enlisted within the course design to ensure that the content is being effectively delivered. The design team must ensure that the instruction utilizes the most effective feature of on-line instruction — its interactivity and is not just a series of lectures, or written text.

Development of the courseware requires specialized expertise and time. Recognized industry standards are from 30 - 600 hours of development time for every new hour of instruction delivered (Golas, 1993). The wide variance is due to the mix of complexity of the subject matter and the type of media and method that is chosen. If we were to choose to teach a relatively low-level skill with some interactivity and utilize a multimedia environment, one may find that 100 hours development time per new hour of instruction may be required. Given that a three semester hour course has 45 contact hours, then the required development time may be 4500 hours — over two person years. The industry also recognizes that a startup project would require much more than the average figures and incurs a risk much higher than normal.

Student Issues

Even before development begins, administrators should decide how the course is to be managed — enrollment in cohort or on-demand. Once the course is developed, ongoing management is required. A faculty member or graduate assistant must be designated to assist and assess the students. Computing resources must be allocated sufficient for the enrollment. Tuition charges must be managed. Typically, tuition costs for these courses are significantly higher than normal courses because of the higher development and management costs. These charges can be potentially adjusted downward through competitive forces as more courses are offered.

As students and faculty must make significant adjustments in the way that they approach instruction in a web environment, so must the administration. In fact, administrators must be active in the development of any institution-wide move to WBI. Support for the development of the instruction must be available. Resources must be allocated for the development of the instruction. Examples may be:

- load adjustment to provide faculty course development time,
- staff direction to provide assistance in instructional design and development,
- administrative time to develop course management, and
- specialized applications for course development and web management.

Scheduling

One of the important decisions that must be made is the enrollment or scheduling model. Current models of scheduling for traditional students are the batch or course-based model. Students choose the course that they will enroll in based on degree requirements and accomplish the courses during a formalized periods that are designated semesters, quarters or terms. This scheduling model is appropriate regardless of the instructional model chosen — a course supplement model or a virtual classroom model. The course supplement model uses the WWW to augment conventionally delivered courses, while the virtual classroom model is one where all instructional aspects are delivered via the WWW and students and teachers may never meet in person (Saltzberg & Paxton, 1995). Non-traditional students may also be in degree programs and thus choose their courses based on program requirements, but a larger number of them are non-degree students who choose their courses based on personal perceived needs and time availability (Butler, 1997). Both traditional and non-traditional students may opt to erase the artificial boundaries created by batch scheduling. These types of students may prefer an open enrollment model that allows students to begin courses at any time and complete them as time is available.

Admission, advising, and registration procedures must also be addressed. These procedures are somewhat tied to the enrollment model. If scheduling using the open model, admission and advising should be flexible. Procedures may be developed to accommodate enrollment, advising, and scheduling via the WWW. Batch scheduling can also take advantage of the convenience afforded by accomplishment via the WWW, however, because it is quite traditional, this method need not be used.

Student Management

Student management procedures must also be developed. Entirely web-based courses may struggle with security because the student is unknown. Admission requirements must include screening strategies to identify the students. Ascertaining who is accomplishing the work is problematic. As students engage in the learning process, additional measures must be devised to identify the students as they proceed through various course activities. The outcomes of a program are dependent on the student demonstrating specific skills or knowledge as a result of the instruction. Without a method of determining student identity, the integrity of the program is in jeopardy.

Transfer policies must be developed. Because convenience and appropriateness for the learner's needs receive a high priority in these situations, the learner may not be persistent in programs. They may "shop" for the best or most convenient course and look at transfer as a means of eventually consolidating courses into a program. Another problem may be how to handle the occasional "convenience course" that is taken to replace a course in a traditional program. How should the course content and administration be verified?

Another student management issue is evaluation.. Even if the security issue is ignored, keeping track of the participation and assignments for a web-based course is a challenge. When there are many students enrolled at different sites, the scoring, recording, and providing feedback can be a daunting task for the instructor. There are courseware such as Asymetrix's *Librarian* that can assist in the record-keeping, but the workload potential still remains. If the open enrollment model is used, there must be an instructor to provide services to the student, regardless of the number currently taking a "course." This may make student to instructor ratios extremely variable.

Student Support

Threlkeld and Brzoska (1994) categorize student support in two ways. The first category is non-content related institutional support, consisting of services such as admissions, registration, financial aid, counseling, and technology assistance. Typically, on-campus support services are available through a variety of offices, providing individual counseling, small group sessions, and written materials to help support the needs of learners. In a web-based learning situation, a distance learning coordinator or facilitator may perform some of these functions, and serve as a student resource person. (Sherry, 1995) The Education Network of Maine Online web site <http://www.enm.maine.edu/> is a good example of both the range of support services available to distance learners, and an effective way of communicating the availability of the services. The second category contains two areas of academic support. The first subsection includes support from faculty, which may include services such as expanded office hours, e-mail contact, and extended syllabi. The second subsection of academic support comes from classmates, and may include provisions for small group work and listservs. One category of academic support services may be added to Threlkeld and Brzoska's list: support to help students learn to become better learners. Students may need assistance in study skills and bibliographic (or library skills) instruction. These foundational support skills may make the difference between success and failure, especially in a situation where students may be highly motivated but lack experience in web-based learning.

Learning Issues

One of the barriers students may face when considering distance learning opportunities is lack of experience and expertise with a range of rapidly changing technologies. It is very easy for an instructor to tell a student to "Sign on to the listserv and participate in the group discussion. Then e-mail me your assignment in ASCII format" without even considering the possibility that a student may not have the expertise to accomplish these basic tasks. Adequate, ongoing support *must* be provided to help students overcome their anxieties about the technologies used for distance learning—students should be spending time on course content, not worrying about how to attach a document to an e-mail message. Access to on-campus technology support personnel should also be available for more challenging problems

Students who are successful in a distance learning environment tend to be mature, highly motivated, and possess well developed self-directed learning skills. At the same time, Moore and Kearsley (1996, p. 155) suggest that "Most adult learners also experience a considerable degree of anxiety about learningÖ. There is a considerable fear of failure." Given this, it is important that students who lack essential learning skills or who are have a high degree of anxiety about web-based learning be given opportunities to master the necessary skills and overcome their anxiety. While maturity and motivation cannot be directly taught, they can be indirectly fostered as a result of the development of self-directed learning skills. Even experienced students face challenges in a new kind of learning environment and they may find that skills that served them well in a traditional classroom are inadequate for learning via the World Wide Web.

Marketing

Finally, marketing issues have to be addressed. Where are the students going to come from? What are their interests? Why should they take your courses? As more and more institutions offer WBI programs, one needs to determine what would attract the student (consumer) to a small institution when a big name institution offers the same program. The program must then direct their efforts

toward filling that perceived need. Accreditation is important in this instance (edTech, 1997).

Conclusion

WBI offers significant opportunities for institutions to open up education to the unserved or underserved, provide new tools to enhance learning, and increase convenience for learners in terms of effective use of place and time. The institution must make a commitment and systematically plan to implement this new form of instruction and faculty should also be aware of the additional time and effort that will be required to ensure the success of these initiatives

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Optimize the Web for better instruction

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The Internet continues to grow in education. In the past few years, the use of the Internet among university faculty and students has soared. Listservs, Web-based courses, and e-mail have become an important aspect in college-level courses. Internet developments, especially the World Wide Web (WWW or the web) offer a great potential to improve instructional practice. A wide variety of tasks may be designed and developed by teachers to integrate the web into curriculum and to engage students in dynamic activities such as exploration, research, discussion, planning, cultural awareness, and publication.

Although many people hold a high hope that the Web will bring tremendous changes in education,, in reality, using the web for instruction is not an easy task. There are many obstacles for web implementation in the school. Lynch and Horton (1997) highlight a few weaknesses the web has presented—being awfully slow, demanding lots of memory, bandwidth limitations, and the expense required to upgrade and to maintain. Monke (1997) also describes the common reality and frustration in school uses of the web, "The education community has been bombarded with hype about the information highway. But in practice, the connections are often unreliable, the interfaces unintuitive, the documentation unintelligible, the information unfindable. And when we do get the systems working, the technology changes so fast that we never feel fully confident about what we are doing." (p. 30)

Issues and concerns

The integration of the web in instruction should involve the following types of tasks: finding resources on the web, retrieving resources from the web, communicating, developing teaching and learning activities using the web, and publishing on the web. These tasks match what Flake (1996) identified as the four key areas of the Internet skills. To integrate the web into instruction successfully, we must take into consideration many concerns and issues related to real life practice. In addition to the above-mentioned issues of the stability and speed in web implementation, many other issues such as resource appropriateness, pedagogical and curricular considerations, designing and publishing effectiveness, and the cognitive impact are of equal or even more importance and deserve much attention. These issues and concerns are presented as follows.

Finding sufficient time and developing good plans are critical for web integration.

Cruising on the web to search for resources can be time-consuming. Developing or maintaining web pages is even more time-consuming. To integrate the web for effective instruction requires thorough planning and extensive experimentation. For example, to engage students in active exploration on the web, teachers should develop learning activities that can link the learning contents to students' prior experiences. Teachers will have to explore all the potential web resources prior to students' exploration. As another example, to develop a good web page, one should plan ahead of time and develop a template containing necessary components so that the web page will meet the intended expectation and can be easy to maintain. Sound web pages will require constant modifications and maintenance.

Students' involvement is the key to the success of web implementation.

When using the web for instruction, students should not be the passive information receivers. To engage students in active learning, teachers should assign students to explore resources, to formulate discussion, and to organize their own information for on-line publication. An elementary school technology coordinator in the southeast Wisconsin, for example, trained some enthusiastic fourth and fifth graders to become technology class helpers who constructed web pages for teachers, classes, and the entire school. They also functioned as teachers' technology assistants. These students, functioning as seed students, continue to grow, help, and influence other students and teachers. Before long the entire school became heavily involved in the web implementation.

Useful web resources are hard to come by.

Teachers should be careful in examining the resources retrieved from the web to ensure that they match the teaching and learning objectives. Many web-using teachers share a serious concern about the inadequacy of the web information to meet the instructional needs. Although there are many resources on the web, most

teachers probably will agree that it is difficult to locate pertinent information to serve the instructional needs. Oftentimes the contents of the resources found on the web are irrelevant, incomplete, or inappropriate.

To locate useful information, critical thinking and problem-solving skills need to be incorporated into the learning process. Users need to develop good strategies of using the on-line search engines to simplify the tasks. Users should learn to choose a proper keyword or combination of keywords for smart search. They sometimes will have to choose different search engines to locate what they need to find. Finding web resources requires time, patience, and practice to excel.

The web should not be used solely for disseminating course materials.

Some administrators advocate saving printing costs by promoting a practice of using the web to display instructional materials and course information. According to such an advocacy, instructors do not give out handouts in class, instead, they put instructional information and materials on the web. Students are required to log onto the web to browse the information as needed. In most cases, as a result, students simply log onto the web, find the information, and print it out from the school printers. It cost even more than using the Xerox machine. Such a policy does not provide students any good motivation to explore the web for learning. Incidentally, such a practice will take teachers plenty of time to put information on the web.

Access to the web is essential for curriculum integration.

An urban school district administrator boasted that his school district had the Internet access way ahead of other school districts. In fact, the teachers from this district revealed the truth that they had only one slow phone line connection in the library which no teacher could access. Inconvenient access is equal to no access. If we want to fully exploit the power of the web for instruction, learners must be provided with an easy access to the web. At present, schools are not well-equipped with the web technology. Most teachers do not have an adequate access to the needed hardware and software resources to support the web-based instruction. In addition, poor scheduling and time management often aggravate the situation.

To increase Internet access, an innovative approach may be developed through cooperation and collaboration between school, community, and universities. Writing small grants to seek community and business contribution may result in financial support to the web access in the school. Teachers and university professors can also work together to explore potential collaboration such as enriching public school students' learning experience by taking a field trip to the university computer lab, or to develop a continuing project that connects the college professional development experience with the public school via the web.

School should create a policy for proper use on the web.

The web has opened a door for misuses. The web is an untamed area where we could bump into almost anything that we may imagine. With the vast variety of the web, two main issues that concern education are the security issue and the copyright issue. Most people believe it is not safe to do transactions on the web. Many teachers, parents, and administrators have expressed their concerns about releasing individual information such as names, addresses, phone numbers, and pictures on the web. Many individuals become aware that a third party in cyberspace might be looking while they are browsing on the web. Individual information becomes vulnerable and insecure.

The problem of pornography, another serious issue, has become pervasive and controversial. Several computer companies have formed the Information Highway Parental Empowerment Group to create standards for software filters that make it possible for teachers and parents to restrict children's access. The controversy over privacy and freedom of speech versus the cyberporn restriction may become a debatable issue and remain unresolved for many years to come. However, an appropriate guideline must be in place to restrict undesirable behavior.

Also, many teachers are concerned about the quality of homework such as the research paper. Individual users can easily copy the resources they have browsed. To fulfill the assignment requirement, students may log into the web and retrieve a portion of an article and paste it into their own research paper. A clear school policy about fair use regarding copyright and plagiarism violation should be established. Copyright issues should be clearly addressed with students so that they know the differences between free resources and copyrighted materials, and know how to properly use and cite other people's work or ideas.

Design a web page with a good purpose.

After learning how to construct a web page, a practicing teacher commented, "Although the process of generating a web page has been made easy, it is still very difficult to develop a good and useful web page." Simply putting text, graphics, or multimedia elements onto a web does not necessarily make it a meaningful and worthwhile product. To make a significant web page, we have to design the page by taking full advantage of the unique characteristics the web can provide. For example, one of the most exciting aspects of web-enhanced instruction is that teachers are able to organize instructional information and include all the relevant references by easily linking to other well-developed sites.

Another important element for a good web page is the inclusion of valuable content to satisfy users' needs. We have to think from the users' point of view about what they

like to see on the web. Since we have seen some web pages as considered as a waste of time or of no value, why do we want to create the same kinds of junk pages? Teaching students to compose a web page, teachers should focus on not only the mechanical part of the designing and development, but also the meaningful contents as well as the global hypertext structure that allows users to cruise around to find relevant information easily.

Other rules of thumb include the basic instructional design and screen design theories. For example, the web page should contain more depth and interactivity for the resources so that teachers can engage students in extensive exploration and collaboration. In addition, the web page should be made intuitive and self-explanatory. The web page designer should also be sensitive to the needs of hardware and software on the users' sides. Undesirable or irrelevant, big graphics should be avoided, and alternatives for unsupported functions or plug-ins should be provided. A good web page for instruction is not only good-looking, exciting, considerate, but also conducive for learning.

Good practice to exploit the web

Good practice to implement the web for instruction requires good planning so that students can concentrate on learning materials and activities within budgeted time. As witnessed by the author, a group of college students were sent to the computer lab to research a certain topic on the web. After an hour, they reconvened in the classroom to talk about what they had learned. Surprisingly, most students did not seem to have achieved much in their experience. They could only contribute to a shallow discussion. With limited time for exploring, it is difficult to stay focused unless a well-organized plan is provided. Otherwise, students will very likely be distracted by other items that caught their eyes.

The web has facilitated an exciting way to engage students in active learning. Contrary to the traditional lecture and factual information memorization, the world wide web as an instructional tool allows student-centered learning where exploration and discussion may inspire students to find information to satisfy their curiosity. The web-based learning can meet individual's needs, motivate students to find resources, and to publish with a creative mind. It also promotes cooperation and collaboration.

Properly integrated, the web can make a huge impact on instruction. However, in many cases today, the web application in instruction still focuses on the mechanical aspect of learning. The courses place a great deal of effort on the following tasks: studying the new terminology, learning to use the web, cruising and finding information on the web, and composing and publishing on the web. Although these tasks are important, the web should not become an independent element in education. Instead, it should function as a supporting element to enhance the content teaching and learning.

Suggestions for optimizing the Web for effective instruction

The web has provided a great potential for instruction. However, in order to maximize the power of the web, we must carefully design and develop instructional activities so that students can benefit from using the web without wasting time. The following are some suggestions derived from the above discussion.

- Plan web-based learning activities ahead of time. Gather needed information. Organize meaningful learning activities to support the web exploration. Schedule needed computer time. Browse through all the suggested web resources before students do it. Prepare a Plan B just in case of the bad connection or some other unforeseen events.
- Relate the web resources with the learning contents and develop instructional activities on the web. Students should explore the web with a clear goal. Random or unprepared exploration on the web often result in a waste of time.
- Watch for proper use of the web resources. Discourage students from pirating ideas or materials from the web.
- Conduct formative and summative evaluation on students' performances. Browsing on the web does not necessarily constitute effective learning. Teachers should conduct needed assessment to monitor students' performance and progress.
- Encourage communication via collaboration and cooperation. The web is a great tool for students to share their own experience. The web-based activities should emphasize the importance of sharing. Teachers should encourage students to engage in active discussion, and creative and critical thinking which in turn may increase students' multicultural awareness.
- To increase efficiency and effectiveness for web exploration, ask students to keep a log about what they have experienced and narrow the focus to the desired resources only.
- When organizing and publishing web pages, authors should consider the needs of the audience. Put only useful and relevant information on the page. Minimize the multimedia elements which may consume too much computer resources to load. Organize information in a proper layout.

Summary

Although the world wide web has become a popular tool in education, to implement the web across the curriculum will require teachers to invest a tremendous effort. This paper addressed various issues regarding the use of the world wide web as an instructional tool. Based on the discussion, some suggestions are provided for optimizing web-based instruction. To sum up, we must overcome the

obstacles of the web access. We should develop innovative instructional activities to motivate students by maximizing the power and advantages that the web can provide.

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WebSite Design as a Focus Agent in Building School Community

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The current fascination of educators with the World Wide Web (WWW) is indicative of a fundamental change of perspective rather than mere curiosity about the hot topic of the moment. This change is occurring at three levels: communal, organizational and personal. Levin (1976) states than one of three motivators for educational change is through internal contradictions such as when indigenous changes in technology lead to new social patterns and needs. This communal level deals with society at large as the Internet with all of its inherent technologies redefines humanity's relationship with, access to, and even definition of, knowledge. Virtual communities are creating new social relationships across distances, gender, and economic levels. Usage of the Internet creates new opportunities for research, defines a new style of discourse and demands new means of composition.

Change is also occurring at the organizational level. At this level, the Internet is a powerful tool with the capability of circumventing the anachronistic hierarchical structure that defines today's public schools. McDonald (1996) identifies this preference for central control in cellular institutions as one of five items on an "unlearning agenda". Such a structure denies the individual school the ability to establish a purposeful community where common standards can be articulated, a vision can be developed reflecting a collective image of excellence, and staff, parents and students come together to form a learning community.

Finally, on a personal and professional level, educators' interest in the Internet reflects a growing acceptance of the constructivist learning model. Technologies can support school reform if they enable teachers to implement new models of teaching and learning (O'Neil, 1995). Roblyer, Edwards, and Havriluk (1996) list five characteristics of constructivist learning:

- Authentic problem solving activities;
- Wide variety and format of resource materials;
- Collaborative work groups;
- Emphasis on problem solving process rather than product; and
- Authentic qualitative assessment methods.

These characteristics can ably be facilitated through thoughtful Internet usage. Harris (1994) and Brehm (1997) divide educational telecommunication activities into four categories: computer mediated communications (CMC), resource retrieval, collaborative projects, and content generation. It is important to note that many educators embrace a constructivist learning model because of their growing awareness of how they, as adults, learn in their everyday life. Therefore, facility with the Internet is seen not only as necessary for their students but also as relevant in their own personal and professional lives as well.

Background

Double Eagle Elementary School in Albuquerque, New Mexico, opened in the fall of 1996 under the auspices of an ambitious collaborative between Albuquerque Public Schools and the University of New Mexico. The core of this collaborative was aimed at creating a vibrant learning community incorporating pre-service teachers, in-service educators, university doctoral students, and university professors. Additionally, ten staff members completed on-site masters' degrees in technology integration during the first eighteen months of this project. Two main goals of this project were collaborative curriculum development and the integration of technology into that curriculum. The emphasis for the first year of the collaborative was on collaboration and working with teachers to increase their comfort level with the use of technology.

The second year has seen the continued growth of the teaching staff in willingness to assume a collaborative stance in a community of learners through bimonthly focus groups centered on reflective practice and action research. Two master teachers at grade levels two and four have become mentor teachers for four university interns placed in double classrooms. Two doctoral students from UNM are on site at the school daily to assist in curriculum development and technology integration while university personnel conduct monthly workshops on campus as well.

In the first year of the project, the majority of classrooms were housed in portables while construction continued throughout the 1996-97 school year to complete the main buildings. This issue prevented full development of the local area network (LAN) at the school. However, by the fall of 1997, construction was completed and the school was projected to be fully networkable for both communications and media purposes.

The emphasis on this networking was to enhance teaching and learning by both the students and the staff. A national study, *Model Nets: A National Study of Computer Networking in K-12 Education,* completed in 1996 by Los Alamos National Labs and sponsored by the U.S. Department of Energy, concluded that networks spark motivation among teachers and students, facilitated on-line information services and enabled intrastaff, intrastudent and intercommunity e-mail communication. However, professional development for teachers in how to plan curriculum that utilizes computer networks as an integrated portion of student learning is often overlooked.

Therefore a major goal for the 1996-97 school year was to concentrate on providing the structure and professional development needed to encourage and support full use of the LAN by both teachers and students in grades 3, 4, and 5. Additionally, through discussions with staff, the need for staff to feel comfortable with the WWW was apparent, as was the need to feel competent in their ability to publish on the WWW. Therefore, a grant was sought from the Corporation of Public Broadcasting Next Step Project to provide the needed software, hardware, and monies for teacher release time. A group of four in-service teachers and one doctoral student wrote the grant application and notification of acceptance was received August 1997.

Project Description

This project was conceived as a means to further the building of a community of learners at Double Eagle Elementary School. It was envisioned that joint participation in designing a website for the school would bring together staff, students and parents. Because a survey indicated that a majority of families at the school had Internet access at home, a website seemed to be a natural communication link. Additionally, many parents indicated that they would like to have the ability to e-mail their child's teacher with questions and comments. Teachers, as well, felt that the site could prove to be a valuable tool in their classroom curriculum.

A website was designed and developed through the coordinated efforts of school and UNM collaborative staff, giving all teachers the opportunity to participate in the design of the website. To facilitate getting the site up and running in a timely manner, a software template developed for Intel was used as the basis for design. This precluded the need for time consuming instruction in HTML and staff agreed that a more personable design, unique to the school, could be developed over the upcoming months. However, staff did have available Microsoft FrontPage and Adobe Acrobat for construction of their personal web pages. A digital camera was purchased and, using the Jigsaw II method by Slavin (1990), certain staff members volunteered to become experts in the operation of the camera as well as 'experts' with PhotoShop software.

The basic website includes a weekly calendar of events, the cafeteria menu for the week, and general announcements. A library page includes suggestions of reading material for children and parents as well as book reviews written by students. A student art gallery gives young artists a place to display their work while another page features a different class each month for a feature presentation. This portion of the website is kept up to date by both staff and parent volunteers.

Parents have contributed to the website by volunteering to serve as 'page parents' charged with updating the basic information databases. The Parent Teacher Organization has a page on which their minutes are posted, the parent community is queried, and the needs of the school are presented. Other parents have begun construction of a page with links to information sources on such items as parenting issues, special needs, and health and development issues.

Individual teachers were given the option of creating their own pages as links to the school site as well. Many teachers chose to move beyond a basic biography approach to this page. Some chose to post long-term assignments on their page as well as to embed links that students could use as on-line research resources. Pre-service interns at Double Eagle, as part of their on-site UNM math methods course, created a math page with links for parents, students, and teachers.

Originally envisioned was a school intranet to provide a virtual space where teachers could meet to plan collaborative on-line projects centered around Writers' Workshop with emphasis on integration with the social studies and science curriculum. HyperStudio stacks, perhaps started in grade three, would be archived to both serve as a learning resource for the student community and to stimulate continued study within that interest as the students moved up through the grades.

Thus was authentic assessment embedded in the growth and depth of understanding demonstrated over a course of time through these HyperStudio projects while encouraging connectivity across grade level curriculum.

Staff received assistance in learning the mechanics of using the LAN/WAN for e-mail capabilities, uploading and downloading files, and conducting research by WWW searches.

Sessions for all interested staff members were conducted on website design and constructing web pages using Microsoft FrontPage. Individuals who volunteered as 'experts' received instruction on use of the digital camera,

conversion graphic formats in PhotoShop, use of the scanner, and basic HTML skills.

Professional development activities were conducted on the effective use of the WWW in the elementary classroom. Teachers had the experience of participating in a WebQuest and later were assisted in developing one for use in their classroom. Excellent collaborative projects on the WWW were demonstrated and explored. Teachers had the option of participating as a member of the I*EARN Learning Circle projects.

Change

Development of a website at Double Eagle Elementary did demonstrate change across three levels: communal, organizational and personal. Most staff members signed up for an e-mail account on the district WAN and learned how to access and manage their accounts. Many joined educational listservs and began to participate in discussions on educational issues with other teachers around the world. Classrooms began collaborative projects with other classes under the I*EARN Learning Circles program. Indeed, the scope of the classroom world did become redefined for these students and teachers.

The bimonthly focus groups did continually emphasize the need for increased staff facility with the WWW. Teachers self-selected the content area of their focus groups as well as their membership in any group. Content areas to be explored in the groups ranged from mathematics to music to poetry to science. However, no matter what the content area selected, discussions within the first three sessions of the focus groups led each group out onto the WWW. Whether it was the need for information, the need for classroom collaboration, or the need for a publishing medium, each group of teachers saw the potential of the Internet as a tool to support their curriculum. Some were not quite sure of just what was the WWW while others, a little more sophisticated with technology, knew how they used it in their personal life but were seeking guidance in how to use it with their students.

Collaborative construction of the website opened up areas of discussion among staff, students, and parents. Acceptable use policies were debated. Discussion was initiated aimed at creating a vision of excellence for the school. Censorship issues came to the forefront with students and parents. Standards for publication for the local site became a focus of teachers and students. Thus, the very structure of the school organization began subtly shifting.

The collaborative design and development of the Double Eagle WebSite involved teachers with a hands-on approach to the technology. Constructing a site, building the pages and mastering rudimentary HTML and web authoring tools combined to give a sense of confidence to each participating member. Additionally, the complexity of the WWW was demystified. By presenting an authentic problem to be solved (create a school website, making available a wide variety of resource materials (software, hardware, and other tools), and coming together in collaborative work groups to accomplish the solution to the problem, constructivist learning was both practiced and modeled.

The collaborative design and construction of the Double Eagle WebSite served as a focus agent in building dynamic school community. It supported organizational change by providing a focal area for discussion and debate. It challenged current definitions of school community by extending the walls of the classroom into the world beyond. Finally, the very act of collaborative website design stimulated discussion of constructivist learning through a dynamic interaction with the five defining characteristics of its methodology.

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Establishing a Framework Useful for Developing Web-Based Assignments in K-12 Education

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The World Wide Web! It's hyper, it's dynamic, it's complex. It's overwhelming! As K-12 teachers or preservice teachers struggle with integrating Web resources into classroom assignments and projects, it's often difficult for them to focus with yet another wonderful resource only one click away. The advantages of using the Web; however, make it imperative that teachers be able to use it effectively. As we work with K-12 teachers, preservice teachers, and education professors, we have found that looking at Web resource use in the following framework has proven beneficial. After introducing the Web in this way in an educational media course, one of the graduate students, a fifth grade teacher, said:

> At the recent teacher's convention I attended two Internet sessions, and both facilitators handed out a list of Web resources and said, "Explore." Applying this framework to Web resources will really help as I develop Web assignments for my fifth graders. I wish I had had this structure before I did the exploring at the convention.

Expanding on the Web levels of use as defined on the "Courses on the Web" page at Oregon State University (http://www.orst.edu/fe/extedu/couvia/), we devised the following structure which emphasizes assignments based on Web use while de-emphasizing the glitz of the Web. The educator purposefully designs a Web-based assignment which adheres to the unit objectives and is appropriate to the environment in which it will be used. Therefore, assignments will be varied according to connectivity, accessibility, student skills, and, of course, classroom goals and objectives.

The Framework: Levels of Web Use

The "levels of Web use" background helps prevent teachers from experiencing that overwhelmed feeling. It allows them to begin with tightly focused assignments that make small and appropriate use of on-line resources, then builds to more complex assignments as they experience success and develop confidence in their ability to use Web resources effectively. What follows is a description of each level of Web use and URL's that exemplify that level of use.

Level One: Informational Use of the Web

This level of Web use contributes to the teacher's ability to disseminate information in on-line form. It is often used to post syllabi, assignments, reviews, sample exams, frequently-asked-questions about an assignment, and even personal and student-friendly information about the teacher. It often takes the shape of a teacher's personal home page. Initially, the information posted may also be distributed in print form to the students, thus making the on-line form an optional source. If, for example, (or should we say when) a student forgets assignment information at home, the student can access the information on-line, preventing teacher interruptions. Vice versa, students and parents with at-home connectivity can access the assignment via the Web.

Posting information on the Web has advantages for both the teacher and student. It is an easy way to become involved in Web use and aids in developing Web navigational skills while teaching students the basic mechanics of Web browser use. In Wisconsin, all it takes is a small blizzard to upset schedules! Adjusting assignment procedures and timelines posted on-line is quick, efficient, and could possibly be done from the teacher's home during the blizzard!

Here are some examples of the informational Web use level:

- Mount St. Joseph High School Foreign Language Department: http://www.msjnet.edu/for-lang.html
  This site provides information about the school's foreign language department. It lists the languages taught and explains the school's language requirement, facilities, and placement policies. Current and future students, parents, counselors, teachers, and administrators can make use of the information.
- Elementary School Media Specialist Home Page: Jennifer Burger: http://comp.uark.edu/~jburger/
  Ms. Burger's home page invites students to get to know her better. Note her use of color, cartoons, and catchy

link titles. Students can develop a sense of Ms. Burger's personality so when they go to the Media Center they may already feel some rapport with her. This site not only helps teachers and students gather a "sense" of Ms. Burger, but Ms. Burger also provides some easy to use links for both teachers and students, thus, providing additional information and resources.

- Dr. Linda Shadiow's Home Page: http://www.nau.edu/~cee/faculty/l.shadiow/l.shadiow.html
  This Northern Arizona University professor's home page is a good example of how the informational Web use level can be used for distributing information on preservice education courses.

Level Two: Supplemental Use of the Web

Supplemental Web use implies that Web resources are used in addition to traditional resources. A well-designed assignment does not fail if Web resources cannot be employed; however, accessing the Web resources through a live connection may enhance and enrich the assignment. It may also provide additional motivation for students to complete the assignment. Web resources can include basic information published by the teacher, but they also can be part of a required or optional assignment to use resources others have placed on the Web. In fact, the majority of supplemental uses include accessing already published Web pages. Some examples of supplemental use encompass using a Web page as one resource, along with print resources, when researching a topic; using a Web page for resource evaluation and critical thinking activities; and locating Web resources through simple key-word search techniques. Students may also be asked to go to a specific site and locate/read/summarize some specific information or a Web-based document.

Some examples of sites that can be used at the supplemental level include:

- Currency Converter: http://www.oanda.com/cgi-bin/ncc
  A middle school business education teacher uses this site as she teaches her students spreadsheet basics. Each student chooses a country and for two weeks tracks the currency conversion rate for that country. The students enter their data in the spreadsheet program and then produce a line graph using the data. The line graph also includes a flag of the country found and downloaded from a Web site. Although the assignment would be successful using non-Web data, the combination of using the currency converter and bringing in images from the Web enriches the assignment.
- The Whitehouse: http://www.whitehouse.gov/WH/glimpse/tour/html/index.html
  Two kindergarten teachers who develop their units around a housing theme, chose the Whitehouse as their theme for February, Presidents' month. The students partake in an on-line field trip, a virtual, historic tour of the Whitehouse. Following the tour, the students design a president's home of their own, naming the rooms and assigning room locations. In addition, the students compose an electronic mail message to the President.
- The Nine Planets: http://www.seds.org/billa/tnp/
  This site is one of several sites preservice students choose from as they complete a Web resource evaluation form. The site critique form involes critically analyzing the site, including appropriate vocabulary for the age level the site is designed for, appropriate linkages, linkages placed appropriately, site continuity, currency, quality and accurate information, and diverse site use.

Level Three: Dependent Use of the Web

In level three, classes continue to meet in a traditional classroom; however, the Web becomes a critical component of a course, a project, or an assignment. Often a majority of the course materials and resources are on the Web, and students can access the material only through the Web. The Web provides access to simulations, exercises, and forms. Links to Web-based activities and resources are usually provided from the teacher's home page or a course home page. Links to relevant resources may also be provided and a certain number of Web-based resources may be required in a research project or presentation. One note of warning, however, as we develop more complex Web projects, we need a back-up plan just in case the technology goes awry, or the sites that we plan to use disappear, move, or change content.

Some examples of dependently used Web sites include:

- Sea Mammals Interdisciplinary Project: http://www.bev.net/education/SeaWorld/ and http://www.bev.net/education/SeaWorld/bottlenose_dolphin/48activitydol.html
  Upper elementary teachers use the Sea World Animal Information Database as their students study sea mammals. Each student group chooses a sea mammal and writes a report which must include particular facts they extract from the Sea World Web resources about the sea mammal. At a related site, students learn the Latin prefixes for sea mammal features. In art class, each student uses the Latin prefixes to create and then draw a unique sea mammal. This art lesson, including the Latin prefixes, can be found at the second URL listed for this example.
- Real-Time Relative Humidity Activity: http://www-kgs.colorado.edu/rt_clouds.html
  This project requires students to gather actual humidity data and submit it as part of a nation-wide weather information data gathering activity. Students engage in real scientific data collection and come to understand the weather scientists' role while learning about the range and effect of humidity in their location.

- Explore Wisconsin Project: http://www.cesa10.k12.wi.us/explore-WI/index.htm
  Funded by a Goals 2000 grant, five rural Wisconsin fourth grade teachers collaborated to help their students research Wisconsin history topics and create Web pages to share their research with the students at the other schools. This is an on-going project which this year includes at least one elementary music teacher who is composing an original song about a local manufacturer. The students will record the song for use on their Web page.
- BioChemistry Research Paper Published on the Web: http://www.chem.uwec.edu/Chem406/Webpages/Kat/mypage.html
  Karen Wysocki, a biochemistry student studying under Professor Scott Hartsel at the University of Wisconsin-Eau Claire, won a Distinguished Award in the '97 Wisconsin Web Fair for writing and publishing this Web-based research paper on the enzyme Carbonic Anhydrase. This type of assignment can be used in any discipline, including preservice education, to teach class content as well as Web publishing skills. For more examples of K-16 Distinguished Award Web publishers see the Wisconsin WebFair site: http://webfair.wisc.edu.

Level Four: Fully Developed Courses Delivered on the Web

Students and faculty participating in a fully developed course may never meet—except through the Web! Fully developed Web courses can serve two purposes. First, they can augment a "traditionally-delivered" course that only meets a few times during the semester. The course content, assignments, communication, and administration is primarily handled on-line. Second, fully-developed Web courses can stand alone. Students and instructors never meet. All content, assignments, discussion, communication, and administration is Web-based. In each case, the course may be supplemented by traditional resources such as books, print library resources, and videos. Timelines differ according to course objectives and purposes. Skill with one or more forms of computer-mediated communication (email, discussion lists, UseNet News, Internet Chats, or groupware) is expected and assumed; Web access is required. Fully developed Web courses force learners to take a greater share of responsibility for their learning. Learners must be self-motivated, good time managers, and demonstrate a high tolerance for on-line glitches. Although most fully-developed Web courses we have seen are directed to adult learners, there are good examples of these courses for high school students as well.

Fully developed web courses are not appropriate for every topic or discipline but can be successful in a range of disciplines. Success requires a carefully planned course that incorporates interaction between the students, between students and course content, and between students and faculty. Other keys to success include availability of technical support in case of difficulties; sufficient interactivity provided by the Web-based course content, and a highly-motivated and supportive instructor (the first time through this will involve a LOT of work!).

Many fully-developed courses require a password in order to access the course itself. The following URLs provide access to the opening pages of fully developed Web courses.

- Advanced Placement European History: http://www.cesa10.k12.wi.us/clustera/apeh/index.htm
  The Cluster A Consortium Schools (five rural Wisconsin School Districts) currently offer this on-line course to qualified students in all five schools. Individually each school would not have sufficient enrollment for the course. Together, they have filled the course and have a waiting list.
- Cool Math 221: http://www.uwp.edu/academic/mathematics/cool.html
  As stated on the Web page, "COOL stands for Calculus Offered On Line. Offered to students via the World Wide Web, its purpose is to reach out to mathematically prepared high school students across the state of Wisconsin and offer them an outstanding educational opportunity." Taught completely on-line, the course is designed to provide students who otherwise might not have it, the opportunity to study calculus before entering college. A math textbook and the software *Mathematica* are integral to the course.
- Flexible Learning System: http://fls.cll.wayne.edu/fls/welcome.htm
  In creating a Web 101 course, the educators at Wayne State University have provided an opportunity for K-12 educators and preservice educators to analyze the structure of an on-line course. What are the issues when developing such a course? What considerations must the developer keep in mind? How many graphics should be used? Does graphical format matter? How does a developer incorporate interactivity in an on-line course? Students have a chance to send their feedback to the developers.
- The Home Education Network: http: //www.then.com/
  Since its inception in the Fall of 1996, The Home Education Network (THEN) has provided over 135 courses to its adult learner audience. Sponsored by UCLA Extension, THEN continually updates its courses and adds new ones.

Advantages of a Context for Web Use

Defining various levels of Web use expands the array of possibilities for educators in a meaningful way. K-12 educators, preservice education students, and university education professors now have a way of categorizing Web use that will help them manage Web-inclusive assignments.

The levels of Web use framework helps educators focus on clear objectives, well-planned, easy-to-follow activities, and distinct outcomes. This way of looking at Web use aids the teacher who is feeling pressure to use Web resources by providing a growth structure where the teacher starts gradually, simply, and comfortably at the informational or supplemental levels. After some initial successes, dependent Web assignments will not seem overwhelming. Another advantage of focusing and planning through this framework is the ability to create interdisciplinary and intragrade assignments. Language arts and math, social studies and music, science and art represent only a few of the combinations that can be made via the Web. A fifth grader may help a kindergartner develop a Web page; two third graders may create art for a sixth grader's story, a group of preservice education students may divide the task of creating a Web page into writer, coder, image digitalizer, editor, etc. As you can see the possibilities are endless.

We cannot overemphasize the importance of focus and planning. The levels of Web use framework helps educators developing Web assignments to focus, plan, and structure assignments and learning to keep the emphasis on the learning and away from the wow, gee-whiz-bang nature of the Internet.

To see more examples of the Web levels of use see Finder and Raleigh (1997). *Web Applications in the Classroom* [On-line.] Available: http://www.cesa10.k12.wi.us/districts/augusta/levels.htm.

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Using the Concept Attainment Model for Web-Based Interventions in Self-Paced Classes

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Self-paced, learner-autonomous instruction is rapidly proliferating, particularly due to the growth of the World Wide Web. The effectiveness of this self-paced instruction has been and is currently being researched with varied results and conclusions. This paper describes a pilot study using the concept attainment model of teaching as Web-based intervention for students in a self-paced class.

With the rapid expansion of distance education and self-paced learning there is a need to examine and modify traditional instructional methods in the context of distance education. Using HTML, the investigator created a Web-based concept attainment intervention strategy to be used in a self-paced class. The concept attainment model of teaching can be defined as the search for and listing of attributes that can be used to distinguish exemplars from non exemplars of various categories. The model requires students to compare and contrast exemplars that contain characteristics (called "attributes") of the concept with exemplars that do not contain those attributes. Exemplars are a subset of data from a data set. Positive exemplars are the subset examples that share one or more defining characteristics that are missing in the other examples. It is by comparing the positive exemplars and contrasting them with the negative ones that the concept is learned.

Learning by concept attainment involves two phases. First, the concept name is presented along with labeled examples of positive and negative exemplars. The learner integrates these exemplars and generates a hypothesis about the concept definition. The student then states a possible definition in terms of essential attributes.

Secondly, the student identifies additional unlabeled examples as positive or negative exemplars of the concept. The student hypothesis and definition is either confirmed or corrected, and a correct definition of the concept is given. The student then generates more concept examples. By following this model the student learns the concepts related to the instructional content. This particular concept attainment intervention was used for reinforcing concepts related to particular subject matter. For this pilot study the subject matter was telecommunications.

Review of Literature

There exits a wide range of studies that consider different kinds of academic interventions. Some may be considered behavioral in nature, in that the intervention addresses behavioral problems or desired modifications within the student. Often the study involves a particular population which may be considered at risk or disadvantaged in a particular educational facet. For example, increased locus of control has been identified as an predictor of academic success. In a study comparing locus of control in very young boys and girls, Bernhard (1994) used a computer-based intervention to try to increase the internal sense of control in both groups. In a study of Black engineering students in South Africa, Meyer (1990) recommended identification of potentially "at risk" students very early in the academic year, and to have explicit provisions of intervention mechanisms to assist such students. Following up with the same population, Parsons (1990) implemented a successful intervention focusing on the teacher/student relationship, perceptions of textbooks and notes, and the nature and role of tests and examinations.

In a meta-analysis of intervention studies that considered the individual students' learning styles, Dunn (1995) found that students whose learning styles were accommodated could be expected to achieve 75% of a standard deviation higher than students whose learning styles were not accommodated. Dunn summarized the results as following:

1. Students with strong learning-style preferences showed greater academic gains as a result of congruent instructional interventions than those students who had mixed preferences or moderate preferences.
2. Studies conducted with small sample sizes showed greater academic gains than those with large or medium sample sizes.
3. College and adult learners showed greater gains than elementary school learners or secondary school learners.

4. Examination of socioeconomic status indicated that middle-class students were more responsive to learning-style accommodations than were lower middle-class or upper middle-class or lower class students.
5. Academic-level moderators indicated that average students were more responsive to learning-style accommodations than were high, low, or mixed groups of students.
6. Instructional interventions that were conducted for more than one year showed stronger results than those conducted for several days, weeks, or months.
7. The content area most responsive to learning-style accommodation was mathematics, followed by other subjects and language arts.

Another meta-analysis of career education interventions on academic achievement found a small positive effect size for these types of interventions. Career education was significantly but not necessarily practically supported as an effective academic intervention (Evans, 1992). For adult learners the use of computer-based counseling interventions is widely used in the area of career counseling, particularly for those workers in transition due to economic factors (loss of jobs, layoffs, etc.). Marin (1991) found that career counseling is most effective with the computer plus the counselor rather than just the computer-based intervention.

Computer-based interventions have also been attempted with elderly institutionalized adults. McConatha (1995) found that computer interaction was an effective tool for increasing older adults' cognitive abilities and daily living skills and decreasing their levels of depression.

Many academic interventions are designed to teach or enhance students' learning skills. There exists a large body of research on study skills and how they may be effectively taught. In a meta-analysis Hattie (1996) classifies these studies as focused on either task-related skills, self-management of learning, or affective components such as motivation and self-concept. Hattie's results support the notion of situated cognition, whereby it is recommended that training other than for simple mnemonic performance should be in context, use tasks within the same domain as the target content, and promote a high degree of learner activity and metacognitive awareness. Nelson et al. (1993) found that knowledge of learning-style preferences increased community college students' achievement and reduced their drop-out rate. Freshmen taught to use study skills responsive to their unique learning styles achieved significantly higher grade-point averages and were more likely to remain in college than freshmen who studied according to traditional guidelines.

Interventions may also be aimed at student retention, particularly within distance education courses. Kember (1990) developed a model to derive such interventions to help reduce drop-out rates. The model includes components of background characteristics, motivation, academic environment, and the family, work, and social environment. Kember derived a series of recommendations for the design of distance education courses. Primary among these recommendations are: enhancing intrinsic motivation; reorienting student conceptions of knowledge; and improving collective affiliation.

In a similar study of interventions for low achievers and potential drop-outs, Kriner (1992) described an initiative for college freshman involving the university counseling center. This study involved a proactive approach by the counseling center staff, as opposed to waiting for the student to seek help of their own initiative. The counseling center identified low achieving freshmen and initiated academic and personal counseling. Results showed a significant increase in grade point average for recipients of this type of counseling intervention.

Short term interventions have been implemented with mixed results. Schultz (1992) describes a model program that would provide interventions designed to assist students to:

1. Develop discipline
2. Understand academe and improve study skills
3. Manage emotions and relationships
4. Develop skills in communication, assertiveness, decision-making, and values clarification.

Schultz points out that additional research might focus on implementing this kind of model as part of a long-term program. Research is also needed to investigate interventions that incorporate all facets of students' environment (Schultz, 1992).

Methodology

Participants in this pilot study were 152 college students enrolled in a self-paced computer literacy class at a large public university in the Southwestern United States. The students represented many different colleges and majors, and ranged in age from 18 to 55. All were taking the class as a general degree requirement. The course itself involved the completion of ten modules, with approximately ten days to two weeks allowed for each module assignment and test. A print-based manual guided the students through the module assignments.

General demographic information was obtained at the beginning of the class, as well as information regarding weekly computer usage and Web and e-mail experience. Midway through the self-paced course the students were required to complete a module on telecommunications. The investigator selected three concepts from the course manual to be reinforced with the on-line intervention. These three concepts were telecommunication software, Internet uses, and on-line databases.

When each participant completed the module work, he or she was directed to the class Web site to complete the intervention before being tested over the material. Upon completing the intervention the participants were required to send the investigator an e-mail message giving feedback about the usefulness of the intervention and about the self-paced nature of the course. For many of students this assignment was their first use of the Web and e-mail.

Results and Discussion

One hundred forty eight of the 152 students were able to complete both the print and Web-based portions of the self-paced module. Of the 148 students completing the module, 140 (95%) were able to pass the module test with an acceptable score after a maximum of three attempts, in accordance with the class syllabus and policies. 83% of the successful students passed on the first attempt, while 14% passed on the second attempt and 3% passed on the third and final attempt. The 95% success rate on the module compares very favorably with other print-based modules of the self-paced course, where passing percentages normally range from approximately 80% to 90%.

Part of the Web-based intervention required students to give feedback on the perceived effectiveness and quality of the intervention itself. Generally the comments were very favorable in terms of ease of use, intuitiveness, and relevance to the subject matter. There were particular suggestions that the participants offered which are helpful in designing future iterations of the concept attainment Web-based intervention. The participant comments were also revealing in terms of learning more about the situated context of this particular participant audience. Participant difficulties and suggestions for improvement are summarized in the following points:

1. Access: Some participants were new to using the Web and e-mail and had difficulty entering a URL and navigating through a Web page. Also, due to the self-paced nature of the class, some participants were ready for the Web intervention much earlier than slower-progressing participants.
2. Graphic Design: Experienced Web users expected pages filled with graphics and possibly animation, while in fact the pages were quite bland and simple in appearance.
3. Difficulty Level: Some students were very familiar with the Web and the subject matter (telecommunications) and found the intervention too basic and remedial. Some students requested more details on how to complete the intervention, having not been previously exposed to the concept attainment model.

Most participants found the intervention to be very helpful and relevant, and the high passing rate for the module test indicates the participants were very successful in mastering the instructional content. Future research will be focused on addressing the aforementioned shortcomings of the Web-based intervention, and on comparing interaction effects of student characteristics such as cognitive tempo, previous academic record, and socioeconomic status.

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Training Trainers to Use the Internet

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The use of internet in a training context modifies implicitly the trainer's behaviour and role. In a traditional training action, one may notice that sharing of the roles between the teacher and the students has been significantly modified. Indeed, in the *digital* era, new technologies make new ways of working and studying together possible. For example, bot collaborative and cooperative work can be facilitated by the use of computers and telecommunications resources. These new and emerging technologies seem particularly supportive of constructivist teaching principles such as authentic instruction and situated learning as suggested by Jonassen [8].

One area where constructivist principles seem particularly appropriate is distant learning. However, this is a new and quite different type of teaching and learning environment when the power and diversity of electronic communication tools are used. Both the student and the teacher must take on quite different roles. This paper describes the competencies one must acquire in order to teach and learn in technology-rich distant learning environments.

The information system within Internet

The information system available for a trainer is mainly characterised by the nature of pieces of information which may vary in many ways. In fact, a triple heterogeneousness can characterise the information:

A. The **heterogeneousness of the type of information.** It expresses the physical diversity (text, picture, sound or video) and the formats diversity of a same object (diversity of origins and freshness).
B. The **diversity of possible indexings**. It can be indexed, for example, by the name or the title, a literal description or a keyword set, a criteria set satisfied in a relational structure, semantic links defined by the authors, etc...
C. The **origins diversity**: local or distant information basis, proximity (means of contact) of the transmitter, etc...

One of the obvious consequences of this heterogenousness is that research strategies and use of information can only evolve over time [15].

Strategies for the search and use of information

It seems obvious that the above A., B., C. points will influence the strategies for the search and use of information.

a. Thus, the **diversity of research modes**, which is possible on the Internet, is a counterpoint to the heterogeneousness mentioned in point A.
b. Moreover, the **strategies for the search** for information, become then very different, depending on the assumed capacity of the user when making out the question. We will particularly distinguish three cases : the case when the needed information is precisely known *(query)* ; the case when the sole domain is precisely known *(query and browsing)* ; and the case when the information searched for is not a priori identified *(pure browsing)*.
c. The **strategies for sorting and discriminating** the information can also be guided by various considerations (the adequacy of information to a pre-defined model, the rareness of information, its cost, its quality, etc...).
d. At last, the **strategies** for the management of information will, among other criteria, depend on the knowledge of data structures and on the task frequency.

The above mentioned points make up a sort of minimum knowledge required to be able to use theInternet, and are prior to any use in an educational context.

Specific knowledge for domain specialists

It seems obvious to us that the knowledge needed for optimal use of internet, which is rather related to concept, cannot be taught to non-specialists quickly and in a traditional way. The descriptions of information and of strategies to be used, which have been introduced at 2.1, enable to derive the needed competencies for the information management. This approach can be used for the training of general information management specialists, but it cannot be directly applied to the training of domain specialists. Indeed, these are not, a priori, interested in becoming information or communication specialists. Thus, a re-wording of the training objectives, using words proper to the domain, must be done. Comments on a set of "cases", illustrating all of the previous contexts, seem necessary, and can help to understand and manage the needed knowledge.

The next section is dedicated to the description of a building method for such cases, that we elaborated the domain of *New Technologies of Education and of Multimedia.*

A building method...

The content of indexed sites on Internet quickly evolves over time. There needs to be some form of at least partial automatic of the process of searching for information if we are not to be overwhelmed by the sheer vastness of the Internet. Recent achievements, based on agents technologies, is an appealing possibility. The global action includes four phases :

1. Conception and development of an information research method related to the multimedia development tools and to the co-operative work..
2. Evaluation of the obtained results and of the automation possibilities.
3. Conception and achievement of a co-operation scheme between operators and software agents..
4. Agents definition and implementation.

The starting point of this action is a formalisation of the *New Technologies of Education and of Multimedia* expressed through a thesaurus.

The domain

The first phase, which permits to model the domain, consists in setting a **thesaurus**. In fact previous works ([20], [22], [23]) published about multimedia, distant training activities, have come to some formalization of the domain expressed by :

1. A plan including four deepness levels.
2. A thesaurus including a « representative set » of key words related to the synonymies among themselves. The thesaurus elements are, case wise, linked to a chapter, to a section, to an under section or to a paragraph of the evoked plan (cf 1.)

The result is a hierarchical structure whose higher level elements will be referred to trough « main key words ».

Starting from this thesaurus, we have built up again **questionning situations** corresponding to the crossing of the cases referenced in 2. (from **A** to **C**) and to the points commented in 2.1 (from **a.** to **d.**). Thus, we get a dozen of different situations, and, in each one of them, we can build up instances which are also different.

Elaboration of an information research method

The search for information, by means of search engines, starting from the *main key words* previously defined, provides thousands of possible references. The method uses as a starting point consists in defining processes for the information filtering in order to methodically extract from it relevant information. This work was inspires by approaches used in electronic documentation and in particular from dynamic links in hypertext ([1], [3], [19], [21]). The result comes under the following forms :

1. A set of information research processes characterised by:
   - Each process is associated to a set of objectives (pedagogical) pre-defined (and parameterable).
   - Each process uses a set of parameters from which some are noticeable within the hierarchical structure evoked above.
   - These processes must be, later on, able to be automatically generated (or according to co-operative methods).
2. For each of these processes, a set of sites or web pages, concrete results of the considered process.
3. An evaluation scheme about the filtering relevance compared to the objectives.

Finally, we show that it is always possible to extract from this virtual corpus a set of significant examples. We focus among them, *questioning which ends up* in a site comprising the searched information and *questioning which does not come to an end*, but where the failure can be explained. The comparison between these different situations helps us refine the search procedure.

Evaluation of the results and an automation possibility thanks to agents

The comparison between sites, or identified pages, and the pedagogical objectives assigned to the corresponding information researches will be tested by *experts*. The results of this *user* test will allow the evaluation of the advocated research method relevance (starting from the scheme 1., 2., 3 evoked in 3.2). This evaluation will have to be able to convey specifications for the conception of a collaboration scheme between human operator and agents, and a precise definition of agents.

Indeed, the multi agent approach is the basis for a technical solution. The multi-agent formalism is based on "autonomous agents ", able to act over their environment and to communicate in order to accomplish collectively one or several tasks [2]. These agents are not supposed to have apprenticeship abilities, but they are autonomous and proactive: they are able to take some initiative and do not react only at the environment's request [5].

There is a *main agent* which is the first to be activated and which activates the others. However other agents may communicate together without going through the main agent or even without informing it. On the contrary, the main agent will receive all the lost messages. This definition is derived from Ferber's *purely communicating agent* [6]. For example, in our case, we could have an agent, who will :

A. know information about other agents: an agent could scrutinise part of the indexed site and would warn an other agent in case of information changes.
B. Be able to communicate with other agents: an agent

would warn another agent in case of a site disappearing.

C. Possess its own resources, which would tell it when to be active, inactive, etc...

D. Have objectives and manage to achieve them, eventually under human control [14]. This is the main point which *secures* the agent's contribution to a cooperative activity.

Thus, all these considerations allow us to oversee favourably, an implementation of our approach under a multi agent formalism [9].

Conclusion

The approach settled upon allows an efficient and precise way of defining a method. It meets the necessity to put into place an almost permanent information research method within a distant and open training system, using the Net information. We are on the way to new tools which turn out to be essential on distant learning platforms.

In parallel to this work, we are in charge of putting into place a distant and open learning platform for a postgraduate training course to multimedia. The conception of dedicated supports, and in particular the description of the multimedia jobs professional practice have allowed to settle a strong link between this project and a case based model about multimedia projects management ([10], [11], [12], [13)].

Underlying theoretical and methodological aspects to the distant training project have been described in the various articles, especially ([24], [25]). In order to bring it into action, the development of numerous interactive supports has been started in co-operation with Masson Editors, and the putting into place of training management devices is done in co-operation with the Distant Teaching National Center (CNED). This project is the basis for a co-operation, under progress, with Sussex and Rouen University in the scope Rives-Manche INTERREG actions.

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A Review of Tools for Developing and Managing Online Courses

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The number of distance learning options offered by universities and colleges is increasing at a rapid pace. In the past, the primary technologies used to deliver distance learning courses were two-way interactive video and one-way prerecorded video (Lewis, Alexander, & Farris, 1997). Although effective, these technologies have their limitations. For example, two-way interactive video requires expensive equipment, and prerecorded video does not offer interactions with the instructor.

The Internet and the World Wide Web offer a new, accessible mechanism for delivering instruction to students. In a study conducted by the U. S. Department of Education, 79 percent of the higher education institutions indicated that they planned to offer courses through Internet-related technologies (U. S. Department of Education, 1995).

Advantages of Internet-based Delivery

Delivering university courses via the Internet offers a wide variety of advantages, offering students new, flexible means of interacting with instructors.

Asynchronous Learning. Technologies such as E-mail and discussion groups allow students and teachers to communicate at times that best meet their schedules.

Synchronous Learning. In many cases, synchronous learning can be accommodated through technologies such as chat rooms and audio conferencing. The software and hardware necessary for these types of communication are minimal.

Minimal Software Requirements for the Students. America Online and other commercial Internet providers now offer full, unlimited Web access for approximately $20.00 per month. In addition, most universities can offer free Internet access for their students.

Minimal Hardware Expenses for Universities. In order to deliver Internet-based education, universities must have Web servers and the associated infrastructure. In most cases, these requirements already exist on campus.

Ease of Course Updates and Maintenance. With Internet-based courses, instructors can upload course assignments and maintain student records simply by connecting to the Web server. Records of the number of times the students have signed in, the amount of time they have spent online, and the scores from quizzes, can be automatically generated.

Decreased Travel Requirements for Students. Access to the Internet has become common-place for a good portion of our society. With Internet-based courses, students are no longer required to drive to campus at a specific time each week.

Worldwide Audience. Statistics show that hundreds of countries are now connected to the Internet. The audience for a course is limited only by access to telephone lines.

Vast Resources of Web. In addition to providing course assignments, instructors can mine the Web for information on almost any subject matter. Bookmarks or links to relevant sites can be secured for students.

The Need for New Software Tools

Despite the increased pressure on faculty members to produce Internet-based courses, the options for developing the courses have been limited in the past. Very few faculty members have the time (or experience) to develop entire courses in HTML or other Internet-based programming options such as JavaScript, Java, or Shockwave. In addition, the management and record-keeping aspects of online courses often requires sophisticated programming.

To meet the need for the development of online courses, several software programs have been developed and tested in the last few months. These tools provide an easy, effective means of creating, managing, and updating courses. Many of them also offer features related to student and faculty collaboration such as chat rooms, discussion groups, and videoconferencing.

Features of Software Tools for Internet-based Courses

Course development tools can provide both the framework and the back-end programming to make the task of delivering instruction via the Web easier by providing:

Web templates, chat rooms, testing, tracking, registration, etc. When investigating a tool, consider the following features:

- Ease of use by faculty
- Ease of use by student (intuitive interface)
- Include various media (text, graphics, video, audio)
- Support alternate character sets (mathematics, foreign languages)
- Various communication models (one to many; one to one; many to many)
- Threaded discussions
- Full text search
- HTML links within courseware
- Application links within courseware
- Student tracking
- Student registration
- Quizzes and online testing
- Automatic student reporting
- Tracking of time/hits/etc. per student
- Free client programs for students
- Ability to access remotely (faculty and students)
- Cross-platform delivery
- Ease of updates/revisions
- Security and password access
- Real-time communication (chat, videoconferencing)
- Online help and phone help (800 line)
- Time limitations feature (set display for 2 weeks, etc.)

Overview of Current Software Options

The software for online education is still evolving, and several new products have recently appeared on the market. This section provides an overview of the features of the following programs: LearningSpace, TopClass, Web Course in a Box, and WebCT.

LearningSpace

LearningSpace is IBM's contribution development tools for Internet-based courses. The software is based on Lotus Notes, using the Lotus Domino server to provide a secure environment for Web based applications. The application includes five specialized Domino databases that provide for the management and evaluation of online courses. For more information, visit http://198.114.68.60/novox/. The features of LearningSpace include:

- The Schedule database. A module designed to enable students to navigate through course materials and assignments, to take tests, and to participate in surveys.
- The Media Center. The media center can act as a virtual library, providing all type of multimedia resources, articles, reports, and links to Web resources.
- The CourseRoom. This is an interactive environment for students and instructors to partake in discussions. It also assists in the student collaboration on projects.
- The Profiles database. The Profiles databases includes student and instructor descriptions with personal information, such as addresses, phone numbers, e-mail, etc.
- The Assessment Manager. This is an evaluation tool for instructors. It provides an environment for instructors to create quizzes and tests, track students, and record grades. At the time of this writing, the quiz generator did not have the ability to generate random questions.

TopClass

TopClass is distributed by WBTSystems. The software is database-driven and allows for remote access, management, and tracking. TopClass runs on multiple operating systems (UNIX, Windows NT, Windows 95, and Macintosh), while supporting numerous browsers. See http://www.Wbtsystems.com/ for more information. The features of TopClass include:

- Collaborative environment. TopClass includes built-in threaded discussion, file attachment, multi-leveled discussion boards, and e-mail components to provide for student collaboration on assignments and projects.
- Online authoring. The instructor interface is designed for ease of use and is based on open HTML standards.
- Security. TopClass provides a robust environment for both individual and group security. It also has remote password protected access for students with all types of browsers.
- Plug n' Play. TopClass includes plug n' play capability to facilitate the transfer of classes from server to server.
- Auto testing. Student testing can be customized to suit student needs, allowing course material to be accessed according to student performance.
- Management. Integrated management allows for personalized coursework, testing procedures, security tracking, and student progress.

Web Course in a Box

Web Course in a Box (WCB) was created by the Instructional Development Center at Virginia Commonwealth University. The software is a template-based authoring tool and is available for download and use at no charge to educational institutions. For more information, visit http://www.madduck.com/wcbinfo/wcb.html. The features of Web Course in a Box include:

- Easy authoring. The user interface is very intuitive, requiring little knowledge of HTML to create and design classes. The system includes interactive lesson builders and quiz builders to facilitate course design by instructors.
- Collaboration. Discussion forums, file attachment and archiving features, self-correcting quizzes provide a learner-centered environment for collaboration, encouraging small group work.
- Security. Access control is placed into the hands of the instructor. The only maintenance required is the creation of instructor accounts by a WCB administrator.

- Modularity. Webs are template driven and can be transferred to any system. WCB integrates easily into any standard Web server.
- Support. Subscription support is offered by madDuck. Support includes a user guide and on site training, if desired.

WebCT

Web Course Tools (WebCT) was developed in the Department of Computer Science at the University of British Columbia. WebCT has been used in the beta test stage by several universities and is now a commercial product. See http://homebrew1.cs.ubc.ca/webct/ for more information. The features of WebCT include:

- Integrated Course Tools. WebCT provides instructors with a host of course tools, accessible through icons, including: e-mail, timed quizzes, conferencing system (chat rooms), grade storage, online grading, student presentation areas, student progress tracking, course glossary, etc. Tools can act in conjunction with one another. For instance, e-mail can be used to send grades to students.
- Testing and evaluation. Quizzes can be designed by the instructor, uploaded, and delivered on a particular time and date. Web CT can also track how long the student spends on the exam and mark it online.
- Student management. Class lists can be entered one student at a time or the entire class list may be entered at once. Student accounts are created by the course designer.
- Design issues. Course pages can be customized for individual classes and/or pages. Templates are provided with multiple choices in terms of banners, counters, course tool icons, etc.
- Tracking. In addition to student progress tracking, access to the class as a whole can be monitored. Instructors may determine who visited individual pages during a particular period.

Conclusion

The selection of the most appropriate tool for creating online courses is a major task for colleges and universities. The investment must be measured both in the cost of the software and in the cost of the time required to create and maintain online courses. This presentation will offer "lessons learned" with several available tools and provide a comparison of features, costs, and limitations.

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Software Tools for Distance Learning: The Benchmarks Project

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Distance education has emerged as the latest wave in educational practice. It is currently the fastest growing form of domestic and international education. Course delivery via the World Wide Web is receiving a great deal of attention from educators and administrators, but questions on how to implement and administer Web-based coursework have been left largely unanswered.

The major problem facing Web-based instructional development today is the development process itself. This process is time-consuming and requires a certain level of computer competency to be performed adequately. New tools being developed to create Web-based learning materials are helping this process along, but a new issue has arisen. Which software should a teacher use to create on-line materials? Which tools work best? What elements are required in a Web-based course, and what software tools perform that function?

Beginnings of the Project

The Center for Excellence in Education at Indiana University Bloomington facilitated the formation of a small group interested in addressing the problem of categorizing and evaluating software. The group members, who dubbed the project "Benchmarks," were self-selecting, with expertise in software evaluation, and considerable experience in teaching and in facilitating faculty use of technology. The group began by conducting a pilot evaluation of on-line "chat" tools, and by developing a taxonomy of distance-education software, a set of evaluation protocols, and a sample Web site putting these protocols into practice.

Successive prototypes of the evaluation protocol, and the apparent soundness of the taxonomy, led to an increased interest in the project's completion and incorporation into a larger, university-funded Web site developed for educators interested in emergent technologies. The project received funding after ten months of volunteer effort, and has since developed and tested a formal evaluation protocol.

In a combined effort to meet the needs of faculty members asked to develop on-line instruction, Indiana University's School of Continuing Studies and the Center for Excellence in Education encouraged and ultimately funded a project to document and evaluate the software necessary to Web-based course delivery.

The Need for Web Tool Categorization and Evaluation

The need for organization and classification of software by type, as well as evaluation of the various software packages within each type, was clearly identified by those educators under pressure to produce distance education courses. There has been little previous research in this area, nor have evaluation protocols been established for distance education development software.

There is a definite need for the organization and articulation of Web-based development tools. First, simply understanding the variety of tools available provides insight on what is needed or possible for a Web-based course. Second, by providing this organization and articulation, instructional designers can reduce the amount of time needed to develop on-line instructional materials, by sharply reducing the sampling and discarding of various tools by uninformed instructors. Teachers already have huge demands upon their time; to require instructional development, modestly estimated at 100 hours of development for one hour of instruction, may prevent many schools and teachers from delivering courses on-line.

Having identified the need for software evaluation, expert review presents itself as the most efficient and effective method. Expert users have little fear of difficult or obscure interface idiosyncrasies and, as designers themselves, are quick to recognize common mistakes made in software design. Expert reviewers are capable of standing in the programmer's shoes, as well as the user's, and are comfortable identifying problems that arise from faulty software as opposed to faulty software use.

Developing the Taxonomy

Originally the Benchmarks team focused its attention on review and assessment of current on-line collaborative activities, particularly those that involved k-12 classroom groups or individual learners in k-12 settings (e.g. projects

offered by TERC, and the Monarch Butterfly Watch project). The focus changed when the School of Continuing Studies requested review and evaluation of tools relevant to their instructors developing on-line courses; additionally, it was decided that the focus would be on tools available at Indiana University.

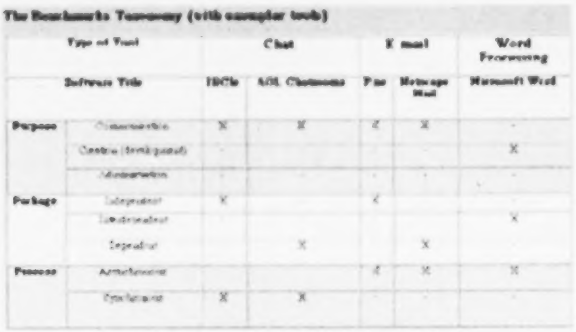

Figure 1. Taxonomy of Web tools.

We began to discuss these collaborations in terms of their shared traits - we noticed that each collaboration required a series of component applications, and that we could categorize these application components in terms of three major concepts: their purpose in facilitating the collaboration (purpose) their relationship to other applications (package) and the time-frame in which they operated (process).

Each application (for example: word processing, on-line chat, e-mail) could be thought of as part of the purpose, package, and process of the collaboration.

Purpose

What a software product does is its purpose. A Web tool will fall into one of three categories: creation, communication, or administration. A fourth category used in the Web site is multipurpose tools, those tools that combine in some way the previous categories.

Creation (development)—creating physical Web elements

Creation tools are those that are used to create the "physical" elements of a Web site: Web pages, graphics, sound, video, image maps, forms, etc. Currently we provide information about the two basic development tool types, HTML editors and graphics tools.

HTML editors are often what people think of when they think of using a tool to develop Web pages. From the Web site, one can better understand that HTML editors are merely part of a much larger whole. However, the uses of an HTML editor are obvious, and using a good HTML editor makes the process of Web development much easier.

A graphics tool can perform many or few functions. However, larger is not necessarily better when it comes to a graphics program. If you only need to save a graphic as a Web-compatible file (a GIF), then you really don't need a program that is extremely complicated. On the other hand, if you are creating or scanning images, a larger graphics program with more functionality will be more useful.

Communication—interaction and information-sharing among class participants.

This category of tools includes chat, conferencing, e-mail, file transfer, and newsreaders. A key element to any course is communication between participants, including teacher-to-student (and vice versa) and student-to-student. These tools provide a variety of communication options, including live versus time-independent, group communications versus one-on-one, and file and news sharing. While many tools can perform more than one function, they often fall primarily into one of the following types.

Conferencing is a vital component to an on-line course because it provides the means for dialogue and discussion as a group. Indiana University is currently reviewing a variety of conferencing tools for potential adoption. File transfer programs are used to move files from a local computer to a shared remote computer, such as a Web server. The step of file transfer is usually the last step in creating a Web site. Newsreaders are not as commonly used for on-line courses; however, they do provide a low-bandwidth alternative to chat and conferencing applications. E-mail applications enable a user to read, compose, send and manage e-mail messages. Users send and read messages at a time of their choosing, without needing to coordinate time with other parties. It provides individual communications (useful for answering and asking questions privately), but can also be used for general announcements and informal discussion, in the form of listservs and distribution lists, and as a convenient interface for file transfer.

Administration. Administration tools for faculty developing on-line courses are often provided by the school — in this case, IU Bloomington. However, there are several commercial products as well. Currently, we have reviewed testing and grade reporting applications.

Multi-purpose. Multi-purpose tools are those applications which are specifically designed to do a variety of things, in order for a developer to work more efficiently. These tools fall into two groupings. Web browsers are just that — Web interface programs. All-in-one course creation tools are those applications which were created for the purpose of developing on-line courses. These tools have much of the functionality of smaller, more specific applications; their advantage is that they are designed to work together. However, all-in-one tools vary widely in their functionality.

Package

Package is that feature of the program which indicates how it is used. An *independent* program is a stand-alone

application. An interdependent can stand alone, but is designed to work with other applications; an example would be Microsoft's Word, Excel, and Powerpoint. *Dependent* tools require the use of a larger application; for example, using America On Line's chat tool is only possible when using America On Line itself

Process

This element is more applicable to those on-line application tools that have time as an important component. This is particularly important for communications tools and collaborative development tools. *Asynchronous* tools are time-independent; participation occurs at users' convenience. *Synchronous* tools are time-dependent, and require simultaneous participation by users.

Evaluation Protocol and Design

The resulting evaluations covered more than 30 creation, communication, and administration tools. We focused primarily on applications available to faculty at Indiana University, since they were our target audience. We developed benchmark tests that were used to evaluate these tools. These tasks were written such that they generated an ordinal number grade; each task was reviewed with the same scale. The scale is defined as such:

1. Very poor capability to perform listed task; feature not available or does not perform as intended.
2. Performs task with only limited success.
3. Performs task adequately, but improvement is
4. Performs task well and with few problems.
5. Performs task extremely well; the task feature was as well designed as could be hoped.

The evaluation results were presented in three types of pages. *Features* reviews examined basic features such as platform, availability, and interface. These reviews included tools that were not fully reviewed but represented popular software available. *Evaluations* pages were comparative results of benchmarks tasks. Figure 2 below is an example of an evaluation page report. *Profile* pages were individual reviews of software, with comments from reviewers included.

The site was also designed to be easily expanded and new reviews included. Because of the size of the site and the potentially large number of software reviews that could be added, it was deemed important to design the site in such a way that future reviewers could add material easily.

This site is available at http://www.wisdomtools.com/benchmarks/bhome.html

	Adobe PageMill 2.0	BBEdit Lite 4.0	HTML Assistant
Easily creates an HTML coded page	5	2	4
Uses conventional HTML code	4	3	5
Provides templates/wizards	1	1	1
Provides help/tutor items	3	1	5
Runs in editor+ mode in browser (WYSIWYG)	5	1	1
Opens/saves stored objects/procedures a variety of ways because	4	1	2
Easily edits text created	5	2	4
Displays images/provides easy image manipulation	4	1	1
Performs basic HTML editing/formatting without user typing tags	5	3	4
Allows user to easily edit tags	5	4	5
Easily creates links	5	3	4
Easily creates tables	5	1	1
Easily creates client side image maps	5	1	1
Easily creates forms (also processing CGI)	5	1	1
Easily changes colors in text and background	5	1	1
Tests pages in browser	5	3	3
Verifies outside links	2	1	1
Checks pages for errors	2	1	1
Provides file transfer function	2	3	1

Figure 2. Sample evaluation table from Benchmarks site. HTML editors.

Note: We would like to express our appreciation and acknowledge the contributions of all Benchmarks team members —Susan Sloffer, Tim Green, Nadine Kwok, Chandra Hawley, and Bill Dueber; and our directors at Wisdom Tools —Marty Siegel and Sonny Kirkley.

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Storytelling and Apprenticeships...Legacies That Can Sustain Technology

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Whomsoever is still awake at the end of a night of stories will surely become the wisest person in the world. An old family blessing. (Estes, 1996).

Recent studies by Harvard Business School professor, Dr. Gerald Zaltman, report findings that would not have surprised a tribal chieftain a century ago, namely that storytelling successfully teaches important lessons to its students (Lieber,1997). Other ancient customs, like apprenticeships, are also being viewed as possible solutions for problems facing contemporary educators.

At the heart of this research is a quest to discover more insights into human behavior. Several methods of sharing insights and lessons have been passed down through both *civilized* and indigenous peoples which include stories and apprenticeships. Ancient legends of child kings learning from the tutelage of wise mentors remind us of these traditions, stories like Mentor, friend of Odysseus and teacher of his son, Telemacchus (Cavendish,1992); tales of King Arthur and his wise teacher, Merlin. Fairy tales like Cinderella relate Cinderella's pygmalion transformation through the magic of her fairy godmother. Modern day legends conjure up familiar feelings with tales like Star Wars, where Luke Skywalker trains to become a Jedi warrior under the tutelage of his mentor, Yoda. These stories exemplify and perpetuate the human connection through generations and may even resonate some deeper, metasymbolic understanding we have yet to discover (Smith, 1997; Salomon, 1997; Baeten,1995). The compelling question is whether these stories can be harnessed together with the modern technology that often conveys them to provide richer learning experiences.

The intent of this study is to look at how culture and communication are transmitted via storytelling and apprenticeships. Avoiding abstract concepts by honing in on an engaging story, and by using testimonials, becomes important as one person shares her/his stories with others. Working and sharing knowledge with others is a natural extension of this process. Dr. Gerald Zaltman's study of stories and testimonials had been conducted initially for marketing purposes, to find out what made consumers buy certain products. But what he discovered in this study had more far reaching implications. As a result, Dr. Zaltman established a *Metaphor Laboratory* to look at storytelling and testimonials to see what other information people conveyed via stories. His findings revealed that people wanted to tell their story, to give testimonials about what worked successfully. And, since this method of sharing knowledge has worked so successfully across many centuries, the likelihood that it could continue to work successfully seemed strong. It remained to be explored whether the stories communicated in person would have the same impact when transmitted electronically.

There may have been more to the legends that old shamans passed down to their progeny than good fireside stories. The youths in those legends lived and worked alongside their elders. They heard their stories and their emotions and psyches were touched by them. They had the opportunity to follow the examples of their elders. Now, research like that of Dr. Zaltman's, suggests that this type of reinforcement can be beneficial to contemporary lifestyles.

'You have to start with proof, not theory, and the proof comes from the stories" (Lieber, 1997). Testimonials and stories become extremely important as one person shares and passes along his/her experiences with others.

So what does this have to do with technology? Particularly distance education? Distance education is changing the fibre of higher education by its accessibility, but more important, by the actual delivery of its academic messages. Currently most distance education courses are delivered electronically, via cable television, in a linear mode of transmission, or via the internet. It is the belief of this author that academic curricula will increasingly be designed for on-line, internet, courses, thus increasing courses offered in a virtual venue of education (Gannon-Cook, 1997a; U.S.A.I.D., 1995). Accordingly, it will become important for future curriculum designers to understand both the delivery vehicle, as well as with the internet courseware. Apprenticeships, or internships, can provide an opportunity to

familiarize the students with this virtual venue of distance education (Dick, 1995; Willis, B., 1995). They could also help students to construct and scaffold their knowledge of curriculum design. But most of all, these apprenticeships/ internships could help students adapt to the constantly changing environment of technology, and prepare them to be change agents by giving them the legacy of shared experiences with their *elders*. These elders could be sixty or twenty-six, sitting next to them in the room, or a thousand miles away (Chalmers, 1997).

Distance education, particularly in higher education, is no longer limited to students at remote locations. Nor is distance education limited in geographic area, social status, or academic qualifications. Higher education is no longer limited to the elite of the academically advantaged, but is now available, virtually, to everyone (Blair & Caine, 1995.)

Today's college students don't have to sit in a classroom to learn or to earn college credits. They have options; they have cable-transmitted classes, videotaped classes, and on-line courses that allow them to complete part, or all, of their degrees on-line.

They are no longer *boxed in* by a limited degree from an American university, a remote Canadian university, or some exotic university in Australia's outback. Students are also no longer relegated to the choices available to them at their local community colleges (League of World Universities, 1997). But the question that is still crucial to on-line, distance education, will be: will this on-line, computerized, *box* provide comprehensive education? Will it also provide educational access that removes socially constructed inhibitors to many who could not, otherwise, receive a college education? Or will it be the proverbial *Pandora's box* that spills out a legion of nightmarish *demons* and backlashes onto the educational world? The ramifications of these new on-line choices are more pervasive than we can now postulate.

The challenges to curriculum and instruction designers in the next ten years will be very different from the challenges of the last fifty years. These challenges may be more akin to those facing educators in the time when the printing press was invented, or when the industrial revolution had just begun in America (Danesi, 1993; McLuhan, 1976; McLuhan, 1968). In each era the paradigm shifted, incorporating the vehicle of communication and content material into the curriculum and the instruction. In each era the availability of education also shifted, providing more information to masses of people who, previously, did not have access to such information. (Stevenson, 1993; Dant, 1991, McLuhan, 1970).

Ancient Storytellers

Just as Gutenberg books were passed on to villagers who had never learned to read, and as children of immigrant factory workers learned in factory modelled schools, the students of today's on-line classes will complete their virtual lessons in their environments and cultures. What this will mean in educational terms, and what this will mean culturally, societally, and politically in the world as we know it, is not discernible yet. But if the medium of conveyance really does become *the messenger* (McLuhan, 1976), then the *messenger* will very likely include a hybrid of every country's educational system and curriculum, every career profession and technology, and every philosophy and political form of government (DelRio & Alvarez, 1995; Wertsch, 1985; MuLuhan, 1970).

What helped people survive radical paradigm shifts in the past? There may be few traces of each civilization and era, but what does remain, in addition to some buildings and artifacts, are their legends and stories. Marcus Aurelius related narratives of ancient Rome, gypsies told stories of Czarist Russia, tribal holy men passed on ancient traditions through their initiates. If academia eschews the generational conveyors of traditions and cultures, can future generations rely solely on the archived databases that will be their legacy? Or might these disks resemble indecipherable cuneiform tablets a hundred years from now? The traditions of stories, legends, and apprenticeships, while not favored as educationally *acceptable* conveyors of information in more sophisticated educational venues, do uphold the oral traditions of generations past (Donmoyer, 1997a; Greene, 1997;Eisner, 1997; Gallini, Seaman, & Terry, 1995). And it is likely, at least in homes and communities where cultural traditions are still maintained, these traditions will continue, at least as long as there are *elders* to keep the traditions alive. So what does this mean to technology? Will there continue to be *parallel* forms of communications, oral and technological, or can the twain meet? It already has in technologies like the telephone, television, and the internet. So, how can this convergence combine the oral traditions of storytelling with the newest technological innovations?

Modern Storytellers

A way to begin looking at how to merge the two realms could be to look at how some of the *rebel* technology innovators are designing their work environments. It is not unusual to see huge open spaces in lofts of buildings or in warehouses and many *pods* or clusters of computers huddled around each other so that the people using them can communicate with each other while working in their virtual environments. A *senior* person (whose age could range from 17 to 95, plus or minus) is available to help each *pod* member and spend time mentoring her/him. And, if each member is encouraged to share ideas and experiences, it can encourage storytelling and testimonials. There are also opportunities in environments, like academia, to foster interaction by using apprenticeships and small group learning experiences to pass on rich information to recipients that might, otherwise, be overlooked (Ferris,

Roberts, & Skolnikoff, 1997; Good, Mulryan, & McCaslin, 1997).

Why Apprenticeships Have Survived

Apprenticeships have been used to train artisans from the days of the dark ages. Stories were handed down from elder to apprentice as they worked together skinning hides and drawing pictographs. The apprenticeship practice was adopted by clerical educators and passed on down through time, to contemporary craftsmen and masons. Internships fill the same function as apprenticeships, allowing the intern time to shadow senior workers and to learn their roles and responsibilities. An apprenticeship is defined as "someone learning a craft or trade from an employer to whom he is bound for a specified period, a learner." An internship is defined as "serving as an intern for a period of time." (While the two terms are similar, the term *internship*, however, is seen more often in education, so, it will, hereafter, replace *apprenticeship* when used in an educational context in this study. [New Lexicon Webster's Dictionary,1992].)

Internships allow the students to spend time with an instructor and learn more about that person's duties and responsibilities. As the students get to know the instructor better, they begin a dialogue that includes both stories and testimonials. Often a student can learn important information from informal conversations about how something works, especially in cases where *hands on* learning and/or equipment are involved (Warner, 1997; Lane, 1992). "Stories researchers tell about themselves often have implicit within them fundamentally different stories about teaching, learning, school organization, and the politics of education" (Donmoyer, 1997b; Smith, 1997). The success of the intern/apprentice will depend on the teacher's expertise and facilitation, so he/she will need to "teach the criteria of quality so thoroughly that the apprentice workers can use them on their own" (Peel & McNary III, 1997; Abramson et al, 1997; Burns, 1995). When structured this way, the model of internship could work in a distance education environment as well as in a *same space* environment, where the students are either literally or virtually apprenticing with the instructor(s).

Technology Internships

A technology internship can give the student the freedom to learn, and the freedom to construct her/his own knowledge, in both environments (Willis, J., 1995; Jonnassen, 1994). Moreover, whether that internship is on-site or virtual, it can provide a firm knowledge base more global in scope than mere classroom theory (Fernlund, 1995, Stevenson, 1993). No longer boxed in by any delimiters, the student can benefit from the close working relationship with the teacher and eventually learn to create new virtual venues for her/himself. Educational internships in specific areas like curriculum design could provide future curriculum designers with *hands on* experience, where they might, otherwise, not have that opportunity. (Once they have graduated, the exigencies of work and/or teaching often prevent the graduated students from having a mentor and a *safe* venue where they can continue learning.)

Technology Corporations, like IBM, purport that education will become more self-directed in the corporate environment, "shifting control of the learning to the student with distance education technology playing a key role in supporting this vision...diverse student base —different ages, cultures...information overload...pace of technological change...all dictate the need for nonlinear (educational solutions), transferable across language/cultures" (USAID, 1996; Lane, 1992).

In an internship, particularly in a distance education environment, students would quickly learn what does and does not work by working closely with an experienced teacher who would answer their questions, share stories with them, and work side-by-side with them. They could work on videos, courseware, cable configuring, and creating curricula for distance education classes under the tutelage of an expert in that field (Gannon-Cook, 1997a). Ultimately, they would become comfortable experimenting and developing their own zones of proximal development (Chalmers, 1997; Fernlund, 1995; Davydov & Radzikhovskii, 1985). And, while students working with a teacher half a world away may not learn quite as much in that virtual environment as students working next to their instructor, there would still be a relationship, a human bond based on the sharing of experiences and stories. If the human factor was encouraged and emphasized, both the instructor and student would derive the maximum benefit from their interaction as well as learning more about their career field.

Currently there are experimental internships, like the one at the University of Houston, Division of Distance Education, in conjunction with the College of Education, that provide doctoral students an opportunity to intern in Distance Education (Gannon- Cook, 1997b, Brande, L.,1993). Internships like these could provide onsite opportunities to help students see firsthand, and assess what constituted good distance educational course design. Over time, information gathered from this research could help students who will be designing distance education courses to scaffold their own knowledge of what would constitute good distance education courseware.

The hope is that, since educational courseware is now assessable through universities almost everywhere in the world, interns could, ultimately, be placed at other universities offering distance education programs anywhere, literally, or virtually. And, with technology changing so rapidly, and its messages transmitted to the far reaches of the globe, the benefits to curriculum designers who are

knowledgeable in state of the art distance education could be invaluable.

A firsthand experience by this author placed her at Cambridge University through the University of Houston. There I had the opportunity to spend time with an instructor from that hallowed university. I was able to ask him questions, listen to his stories, share anecdotes, and participate in what my instructor called *The Cambridge Experience.*

Part of the inspiration for this study came from my Cambridge adventure. I will never forget one of Brent's (Dr. Robinson's) folktales, based on the *Sabertooth Curriculum* (Robinson, 1995). The story told of how, for years beyond the extinction of the sabertooth, cavemen still taught the art of sabertooth slaying. One day a brave teacher stood up and began to teach buffalo slaying instead of sabertooth slaying. And the cavemen survived. Brent's eyes lit up as he shared the enthusiasm of that buffalo teacher, and Brent's wisdom infused all of us in ways we have yet to discover. While I personally felt that physically *being there* was an invaluable experience that could not be replicated in a virtual realm, there could, no doubt, still be significant benefit in this type of apprenticeship in a virtual environment (Gannon Cook, 1996). The Cambridge course continued in a virtual mode after returning home, thus offering a combined real and virtual experience. This type of internship could provide the optimum learning situation for both students, instructors, and university sponsors.

Messengers of Human Legacy

As educators, we must anticipate and plan curriculum and instruction based on the successful models of the past. Just as the examples of the printing press and industrial revolution extended learning to a broader base of learners, mass delivery of education begets access to unlimited numbers of learners. In the example of the worldwide internet, mass delivery of distance education will extend to infinite numbers of learners from every country and culture. It is incumbent on distance education designers to be knowledgeable about what is and will be available to learners, both in-house at their home universities, as well as globally at other learning institutions.

The future of education will, likely, include even more technology. Higher educational programs that give students the opportunity to learn both the technology and the theory of instructional design optimize their learning environments. Internships like that of the University of Houston provide a rich environment for learning and exploration. While the *messenger* or delivery vehicle of distance education may be technology, the educational message is still created and presented by a human designer. Internships can help aspiring designers to get a perspective of how the process of design integration occurs, not just in theory, or on paper, but in practice, from inception to ongoing operation (Moore & Kearsley, 1996; Loyola, 1994).

A Matter of Course: A Discussion

Ongoing training will continue to be necessary in technology because of its ever-changing nature. Training will be particularly important in distance education venues, or future curriculum designers will be ill-equipped to design courses in those venues (Moore & Kearsley, 1996). Internships and apprenticeships could provide *neutral* learning zones for not only students, but also, ultimately, to corporate and other interested parties who might be serious *seekers* in search of a safe learning harbor (Blair & Caine, 1995; Stevenson, 1993). The legacy of passing down stories of what works...and what doesn't, through intern apprenticeships, might offer students a multi-sensory, nurturing, venue for learning. Incorporating ancient traditions like storytelling and testimonials into technology might help transmute teacher/student hesitation or resistance into acceptance, or at least predispose them to set the course for technology adoption. The hope would be to provide the teachers and students with a legacy of learning that has been successful in the past, and will sustain and thrive in future environments, both real and virtual.

Acknowledgements

An intervening factor that made this internship even more memorable was the untimely demise of our instructor upon our return from Cambridge, Dr. Brent Robinson. But, because of this wonderful experience, his stories and legends will live on. They will forever color my teaching and commitment to distance education, along with the others who participated in the course. Special thanks to Dr. Jerry Willis for co-creating this course with Dr. Robinson. Sometimes the educational benefits of internships far surpass one's most creative anticipations.

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Faculty Recruitment, Training, and Compensation for Distance Education

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The Virtual Classroom is a metaphor that has been used to help reconceptualize the methods by which education and training is facilitated from kindergarten through graduate school and into the workplace. It suggests that the organization of learning need not occur in the traditional spaces that all of us have historically associated with educational activities. The metaphor is useful for many reasons; it enables us to think about classrooms, to think about organizational alternatives, and to think about how learning might occur when activities are actually separated from their traditional framework. The virtual metaphor fails us, however, when it conjures up a notion of things that are "not real." Education and training will always involve "real people" promoting and pursuing a "real activity" called learning. It is only the metaphor itself which is virtual.

Recognizing the "realness" of the people, the activities, and the outcomes of organized learning is important because it is on these "real" factors that our attention must be focused ever more intently. While there are many aspects that need to be addressed relative to the new roles of faculty and students for distance education, the purpose of this paper is to help recalibrate our strategies for faculty recruitment, training, and compensation.

Distance Education and Learning Defined

Although Distance Education has been defined in many ways, for the purposes of this paper, Distance Education should be understood as planned experiences which result in changes in a client's cognition, affect, and/or behavior when the learner is physically separated from the sources of knowledge and instruction. Distance Learning is the set of activities in which clients participate which results in changes in the client's cognition, affect, and/or behavior when the client is separated from the sources of knowledge and instruction. These definitions are important because they imply faculty roles which are not necessarily explicit in traditional faculty job descriptions, but are characteristic and desirable in distance education. The three major roles for faculty include: curriculum planning and design, instructional management, and evaluation.

Faculty Recruitment

Traditionally, faculty have been hired to come to a campus or school building. This often required a deep financial and logistical commitment on the part of the organization and the individual to develop and sustain a relationship. Universities and colleges have historically treated faculty hiring as a decision which would have significant and long term impact on the educational direction of the academic unit. Hiring a full-time faculty member was as much a philosophical decision about programmatic futures as it was a personnel action. Employment was not an action entered into lightly by either the institution or the individual. Adjunct professorial hiring added some flexibility to the activity of faculty recruitment, but the pool was usually limited to local talent. In non-metropolitan areas, finding qualified adjuncts was at least difficult, if not impossible.

Distance technologies and the paradigms of distance learning created new possibilities for staffing. Although universities have been hesitant to exploit these possibilities, a number of options are inherent. Distance technologies include media which makes it possible to "record and/or distribute" expert knowledge in ways which expand upon the use of traditional books and papers. Video and audio recording, computer based instruction, telephone based audioconferencing, compressed video, satellite transmission and other media make expert knowledge accessible to not only appropriately equipped classrooms, but thousands of remote sites, including home or office. Even when they are hired on a very limited basis these experts greatly enhance the expert content of any class. The same experts can also be hired to conduct an entire class as an adjunct faculty member even when they live hundreds or thousands of miles away. Full-time faculty also

benefit directly from greater flexibility when they need to be away from campus for field research, conferences, or other travel reasons. Additionally, these approaches can be combined in collaborative teaching models to permit faculty from multiple campuses to teach together to a group composed of representatives of each home campus and others. Whether these options will be explored will be decided by faculty themselves, and the demand of market forces (Denning, 1996).

The new options evolving from distance technologies create opportunities for innovative recruitment strategies and options. All institutions, even small remote ones, can advertise nationally for expert faculty to expand or complement their core faculty resources. Recruitment can be designed to attract faculty to teach entire courses or special modules, which only require modest time and effort, but special expertise. A more diverse faculty can be attracted to cover topics from a unique regional or cultural perspective. Retired faculty can continue to participate in the life of the university as they are needed, and as they desire, from wherever they may have relocated. Large numbers of students in one class can be managed by one regular faculty who manages the course and others who contribute their special expertise and share the load for interactivity and evaluation. Some faculty can be hired exclusively for course design, while others are hired for instruction. Whether the model is individually oriented or team oriented, distance technologies mean that a more diverse, better qualified, more talented, and flexible pool of potential faculty become available to all institutions.

The net result of more faculty and more institutions vying for their participation will be more competition. Institutional loyalty and proximity are still factors in faculty decision making, but incentives will become increasingly important especially as a professional group of free-market distance educators emerges. Institutions that wish to recruit the best and the brightest faculty will be well advised to follow traditional lessons in the context of a new reality. Faculty teaching at a distance will not be enticed by a move to a cultural center or research facilities, they are more likely to be enticed by situation which provides them a great deal of flexibility. They may be motivated by an institutional affiliation with an institution renowned for excellence in traditional and distance programs, but they will certainly be motivated by those institutions with the most interesting curriculum options, best support services, and most enticing compensation packages.

A recruiting strategy which uncovers high quality faculty who are available, skilled, and willing to follow institutional policies is essential and must be carefully planned and executed. Involved in this process is advertising, a review procedure for credentials and work products, a detailed list of performance specifications, and a work agreement.

Faculty Training

It is likely that the largest and best financially endowed institutions will have an advantage in recruiting not only the most knowledgeable faculty, but also the most skilled at distance education. Institutions of all kinds, however, will need to pay attention to faculty training. While some education and training can be delivered at a distance by even the uninitiated, normal communications skills are inadequate to achieve effective learning results across the diverse methods of distance education.

To achieve a high performance solution, it is imperative that a systematic approach be applied to the planning and development of distance learning materials, instructional methods, and communications infrastructure (Laney, 1996). Traditional course preparation ranges dramatically among higher education faculty. Many faculty prepare little more than a topical syllabus and allow lessons to emerge from classroom interaction coupled with the personal expertise of the faculty. Other faculty prepare learning objectives, activities, and materials, but few have training in these endeavors. It is precisely because clients and faculty are physically separated that course structure and materials must be developed in a systematic manner that reduces the possibilities of misinterpretation and confusion.

Adding to the complexity of the task is the fact that distance education is not one style of education, but a collection of styles dependent on diverse media and methods. Preparing faculty for teaching in variety of distance settings with a variety of communications media requires both common and unique methods. Obviously, the many media available to distance educators can be combined to provide a rich multiple source media learning environment. For the purposes of this paper, however, the media will be limited to four: videotape for asynchronous delivery, compressed video for synchronous delivery, World Wide Web based text with graphics for asynchronous delivery, and computer based conferencing for asynchronous delivery.

Before exploring these four categories is important to restate, that while traditional faculty roles have included course conceptualization, course preparation, course delivery, course management, and evaluation components; it is not necessary that one faculty perform all these tasks. Collaborative efforts focused on differentiated staffing emphasizing individual strengths may indeed be one of the sweet fruits of distance education. Too many expectations for faculty without appropriate training and support can create a significant barrier to faculty use of technology (Boettcher, 1995). Institutions should provide convenient and supportive faculty development opportunities aimed at high quality educational experiences.

In general, the best technique for learning to use distance education technologies is practice. Skill develop-

ment evolves over time in real life situations. It is a good idea to have faculty participate as learners or observers in settings which use distance education strategies, then have them contribute information or lessons to an existing class. Finally, allow new distance faculty to design and develop a lesson without the pressure of having to deliver the actual lesson. A great deal will be learned by actually going through "all" the step involved.

Generally, new faculty need to learn how to establish and maintain contact at a distance. They should attempt to create situations in which they reach out to the clients personally as though they were writing a letter. They should think about engaging the clients and communicating to them by anticipating their questions and confusion. Finally, new faculty should determine how they can best evaluate learning in a distance context. The signs are different, but the students needs are the same. Obviously, the institution should provide as much help and support as possible to these efforts on the part of faculty, but it is the individual that must do the thinking.

Videotape for asynchronous delivery involves some kind of studio or field production of a presentation, electronic field trip, or demonstration and variations on these themes for delivery to clients to view at their convenience. Faculty should watch several examples of high quality examples (within the production guidelines of the institutional producer) to begin conceptualizing the kind of production that can and should be accomplished. Next the faculty should work with a director to create several simple samples of on camera work, listening carefully to the director's advice. The samples should be reviewed with the director and redone for comparison purposes. Finally, some samples should be created and shared with colleagues and students for feedback. The production guidelines for each institution will dictate a good deal about what can and can't be done, but these should always be stretched in the interest of good quality instruction.

Compressed video for synchronous delivery is the use of a two way audio and video connection to a remote site or sites in real time. Compressed video has the advantage of seeing and hearing how students react to the faculty presentation, but because it is in real time more can go wrong and often faculty are in complete control of the process. As with videotape production, good planning and materials preparation are essential, and screen presence techniques are similar. In compressed video however, the instructional situation must be managed at the same time as content is delivered. Faculty should practice with different groups and to video tape for later study. Coaching during the initial learning phase is essential and faculty should be open to suggestion. As with videotape production, however, practice will deliver its reward.

World Wide Web based text with graphics for asynchronous delivery is the distribution of HTML documents through the Internet for remote viewing and reading. Skill development with the World Wide Web is different that with video production; most important for faculty is the ability to plan and design learning resources that work well within a hypertext and hypermedia environment. This is most efficiently accomplished through the use of an instructional designer or similar support person. Faculty may also want to develop skill in HTML coding, in order to quickly update documents and add resources. HTML knowledge is not essential, but should be provided as a support resources by the institution for document creation.

Computer based conferencing for asynchronous delivery is the use of a computer based system for communicating through the use of electronic mail, newsgroups, or web based conferencing. Almost all faculty now use some form of electronic communications for sharing information. There are techniques that need to be developed to make this work effectively. Most important is the development of a careful communication style that does not inadvertently offend. It is also essential that skills in file transfer and attachment be developed as well.

Faculty are not likely to seek out assistance in learning these techniques without some motivation and encouragement by the institution. It is imperative that institutions establish a comprehensive faculty development program and require those faculty who want to participate in distance learning to participate. Faculty with well developed skills and experience will work with confidence and effectively represent the institution.

Faculty Compensation

One of the most challenging questions to confront those familiar with traditional models for compensating faculty is how to convince faculty to engage in the extra work, responsibilities, and time required by the typical distance education project. While there is no single solution to this problem, a number of creative responses will be presented from which administrators and managers can construct fair and enticing methods for compensating faculty fairly.

Compensating faculty is and will continue to be a complex problem. There is no question that on a course to course comparison with the same number and same quality of students, a course formatted for distance education requires more time, thought, creativity, and effort, than a similar classroom based course. Issues of equity, measurement, quality, cost and revenue all come into play. There appear to be three basic institutional responses to the question. One model is to offer distance education through a division or school of continuing studies with a separate faculty or separate compensation structure, a second model is to pay faculty overload salaries, while a third approach offers faculty a percentage of the revenue generated from the courses. Each response has a strengths and weaknesses dependent on the institutional context in which they are implemented.

While aspects of these three models may work well for individual institutions, the position offered here is that of a differentiated staffing model. This simply means that an individual faculty member would become part of an instructional team comprised of specialists in different aspects of the distance education provider responsibilities. Each of these team members, (e.g. subject matter expert, course manager, video producer, instructional designer, evaluation designer, technical support personnel) would negotiate compensation based on their contribution to the project. Part of the negotiation on the part of the faculty would be a decision as to whether the tasks were part of their basic teaching load, an overload, or a form of service for supplemental compensation could be provided.

The team approach guarantees multiple inputs into the development process, does not infringe on academic freedom, reduces the burden of distance learning on the individual faculty, and creates a common practice from which a standard design quality emerges without inhibiting creativity. Unlike the traditional conception of classroom based instruction, approaches to distance education vary widely and each design ought to be treated separately to guard against the whole endeavor collapsing into a single standardized approach.

The success of Distance Education will require a dynamic approach to problem solving and policy flexibility on the part of organizations. The significance of the roles that faculty will play in this process cannot be underestimated and clear thinking in advance will avoid many problems in the future.

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Strategies to Support Effective Distance Education Programs in High Schools

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Distance education, when defined as an educational transaction between a teacher at one location and a learner at another, dates back to late nineteenth century correspondence courses. Today, distance education encompasses a myriad of delivery systems that provide learning opportunities to students of all ages (Moore & Kearsley, 1996).

During the past decade, American high schools began using distance education technologies to offer students courses in math, science, and foreign languages. These courses often use a teacher-facilitator-student model where the teacher is at a remote site and the facilitator and students are in a local classroom (Tushnet, 1994). Teachers and students have always been major components in educational systems, but the classroom facilitator represents a new component. Little is known about roles classroom facilitators play in distance education, how they affect other components in the system, or how they affect system outcomes (Willis, 1992).

This study was initially designed to identify the roles of classroom facilitators and students within the context of a high school distance education course and to examine how those roles affected student performance. However, it quickly became apparent that the school itself played an important part in facilitator and student behavior and achievement. Consequently, the focus broadened to reflect a realm of variables, including school attributes, that influenced distance education in this setting.

Design of the Study

An ethnographic, multiple case study research design was used for this study. Three classrooms from different high schools (South High, Central High, and North High; all fictitious names), each taking the same nationally-offered distance education physics course during the 1994-95 school year, participated. The course was delivered live, via satellite. Telephones and a computer keypad system connected the students with the remote teacher. The course design included 30 minutes of instruction and other activities provided by the satellite teacher, as well as a 20 minute off-air period during which the facilitator and students did homework, discussed problems, or did labs.

The research methodology included extensive classroom observation, informal and formal interviews with classroom facilitators and students, and review and analysis of student work products, extant documents and resources used in the course. Each participating physics class was observed daily, in its entirety, for two consecutive units of study. A third unit of study was observed later.

A purposive sampling strategy designed to provide maximum variation was used to select the participants. Case variations included (a) facilitator certification (science, social studies, not certified); (b) facilitator distance education experience; (c) class size; (d) student demographics; (e) match of the school and distance education course bell schedules; (f) number of distance education courses offered by the school; and (g) location of the school (two adjacent states, three school districts).

An inductive constant comparative method was used to analyze the data. Collected data was transcribed, compiled, and coded; and then compared and contrasted to identify patterns and trends. Triangulation of data collection methods and data sources was used to enhance reliability and validity.

School Impact on Facilitator and Student Roles and Performance

The schools in this study had a major effect on facilitators and students. The high school calendar, including student and teacher holidays, and special events scheduling such as pep rallies and assemblies, affected how frequently students missed regularly scheduled distance education classes. This, in turn, affected facilitator roles in terms of planning for students to make up missed coursework. In one school the facilitator just taped the programs and made them available to students; in another the facilitator showed the makeup tape during a later class period; and one facilitator had to plan special make-up periods outside class. Ultimately, student performance was affected by

when, and if, classes were made up. This was particularly evident at South High where many school holidays failed to match the distance schedule, and where a number of special activities disrupted class. In addition, over half the students at South High missed Physics once a week for an entire semester as a result of another class. As the South High facilitator noted, "If they miss it and don't make it up, and then they get lost, it's a wipeout. They never catch up." Thus, the school calendar had an adverse effect on student learning in Physics if it meant students missed classes to the degree they got behind and couldn't (or didn't) catch up.

The school bell schedule also influenced student and facilitator activities. At North High a German class was scheduled at 9:00 a.m., just as the off-air Physics time was beginning. As a result, physics students went to the media center for the off-air segment and the facilitator stayed with the German class. This meant the facilitator could not participate in off-air activities with the physics students, and she felt this was detrimental. During previous years, she had used off-air time to encourage students to call the physics teacher with questions they did not understand, or had encouraged them to do homework together on the chalkboard. These activities allowed students who were having difficulty to get help, either from the physics teacher over the phone, or from the other students in the class. However, the 1994-95 North High physics students were reluctant to call for help unless the facilitator actually placed the call. Due to the scheduling of the 9:00 German class she was rarely able to do this. Cooperative learning through mutual homework review rarely occurred because students spent the off-air time in the media center visiting with each other rather than doing homework. Students in the media center were also unable to complete lab or other activities that required equipment access. At South High School, the bell schedule split the off-air period into two short segments that tended to be wasted by the students.

School registration procedures had a major impact on North High students in terms of pre-requisite skills. The physics course required Algebra I and II as pre-requisites, but a number of North students were misadvised and did not meet these requirements. As a result, most of the North High students had poor math skills and were unable to perform the algebraic procedures required in Physics. Consequently, their acquisition of physics skills suffered. While the facilitator became aware of the algebra deficiencies early in the course, she had no way of providing remediation.

Prior school experiences also affected physics students. North High students had chosen Physics because they had heard, from other students or the chemistry teacher, that Physics was easier than the alternative chemistry course. So, their expectations were that the course and the work required of them would be easy. While a number of the students at South High perceived that Physics was a more difficult science, the amount and kind of work they were used to putting into courses did not prepare them for the effort required by the distance education physics course. Many lacked adequate study skills and discipline. The South High facilitator observed, "I think this class requires more from them than they've been used to. They need to look at Physics every night, and they just did not do it." And while all but one South High student met the algebra pre-requisites on paper, most believed that the skills they had acquired in their algebra courses at South High were inadequate.

School drop policies for distance education courses affected some students. None of the three schools allowed students to drop distance education courses after tuition had been paid to the course provider. But, several students at South and North High Schools indicated they would have dropped the course had that been an option, since they were doing so poorly in it. The drop policy may have indirectly contributed to a test retake policy at South High and a lenient homework policy at North. Both policies provided an opportunity for students to improve their grades although the policies did not support student learning. Generally, the South and North High facilitators did whatever they could to help students pass the course since they could not drop it.

Other school responsibilities affected the amount of time the South High facilitator actually spent in the classroom. The South High facilitator was a full-time school administrator, and as a result she periodically missed entire classes for several days or a week due to meetings, workshops, or other school obligations. Since she was an administrator, substitutes were not hired to take her place as facilitator. Missing classes meant she had to catch up on what had been covered in Physics, determine what students had or had not done, and then decide how students would make up missed activities. South High students indicated they did not stay on task and found it difficult to pay attention when the facilitator was away, so the regular learning process was always affected when she was absent.

Facilitator Roles and Their Effect on Student Performance

Facilitators at all three schools agreed that their primary focus was on classroom management and climate, but noted they engaged in some planning and instructional tasks. Logistical planning and implementation was a major responsibility. All three duplicated instructional materials developed by the physics teacher and distributed them to the students. They maintained lab equipment and prepared the classrooms for lab activities. They also decided how to accommodate deviations between the school and physics calendars and schedules. The physics teacher delivered most of the instruction, but occasionally the facilitators provided supplemental guidance or feedback as they

responded to student questions. The South and North facilitators occasionally answered informational questions directly, but more frequently directed students to other resources such as other students, teachers, or the telephone tutors. The Central High facilitator had a science background and was able to answer student questions personally. The North and South High facilitators played a major role in gaining (and maintaining) student attention during class and in eliciting student performance during labs and other in-class activities. The Central High students tended to stay on task, paying attention and participating independently, so the Central facilitator rarely had to assume these roles. All three facilitators implemented the testing and student assessment activities planned by the physics teacher. Each facilitator instituted grading policies and procedures that they thought were appropriate for their students and instructional setting. For instance, at South High students were allowed to retake tests for extra credit and at North High students were allowed to turn in homework long after it was due.

All three facilitators assumed classroom management roles, although the North and South facilitators were more active in this area. The Central facilitator reported, and classroom observation confirmed, that Central High students were mature and required little supervision, while the other two facilitators were continuously working to keep South and North High students on task, paying attention, behaving appropriately and participating in classroom activities. At South High the facilitator constantly reminded them to pay attention and participate in class, and she always coached or guided students through labs, since they tended to sit idly without her direct intervention. The students themselves reported that it was difficult to pay attention when the facilitator was absent. At North High the facilitator sat among the students to keep them on task, and frequently interrupted student conversations or other off-task behaviors to get them to focus on Physics. Students at North High indicated that they found it hard to concentrate and pay attention and relied on the facilitator to keep them on task.

The facilitators also assumed classroom climate roles, displaying positive attitudes toward the course and instructor, encouraging positive student attitudes and trying to build supporting relationships with and among the students. The South and North High School facilitators tried to work with other teachers in the school to make them aware of special needs or dispensations the physics students required as a result of their participation in the distance ed course. In all three schools, facilitators maintained indirect contact with parents through mid-term grading period progress reports. The North High facilitator also maintained direct personal contact with several parents who were concerned about their child's performance in Physics. Students at all three schools attributed their positive attitude toward the class to the facilitators enthusiasm.

Other Factors that Affected Facilitator and Student Roles and Performance

Individual student aptitudes and other academic skills and experiences also affected the physics students and facilitators. At Central High, many of the students had taken Physics because they were interested in the subject. The facilitator observed that most of these students were gifted, and that all had a great deal of initiative and self-responsibility. The Central students stayed focused and attentive during class, rarely had trouble grasping concepts, and found the pacing of the physics class to be satisfactory. They had good study habits, recognized the importance of solving homework problems rather than copying answers, and had good test-taking skills. They also took responsibility for making up classes they missed by taking tapes home or viewing them before or after school. Consequently, their academic performance was good, and the facilitator rarely had to intervene or provide direct support for class activities.

This contrasted with the students at South and North High, most of whom were average students with average academic backgrounds. They had more difficulty staying on task and paying attention, inadequately utilized instructional resources, occasionally found the pacing of the course too fast, frequently copied homework answers just to get credit, and employed educated guess strategies when taking tests. They tended to accept less responsibility for their own learning, relying on the facilitator to help them focus or to make sure they did their homework or labs. While some of the students at North High reviewed tapes for classes they missed, only one South High student routinely made up missed classes without direct facilitator intervention. Facilitators at these two schools provided a great deal of support and guidance during class to help students to pay attention and participate in class activities, to actively help them complete assignments such as labs, to make sure they turned in homework, and to encourage students to utilize supporting outside resources such as the tutors. While some of the South and North High students performed satisfactorily on tests suggesting that they had mastered physics skills covered in class, a number of students at these schools relied on homework credit and good lab scores to pass the course.

Facilitator backgrounds also contributed to facilitator roles. Since the Central facilitator had a science degree, she could usually provide immediate answers to any content-related questions students might have. The other two facilitators might be able to answer some physics questions — based on things they had learned in previous years — but their more frequent information/feedback role was to direct and encourage students to use other resources to find answers. Some of the South and North High students indicated that they called the tutors and found them helpful, but many were reluctant to call or found it difficult

to communicate with the tutors. And, since a student's ability to clarify and resolve conceptual or procedural questions ultimately affects student learning, the Central High students' physics performance was influenced to some degree by their facilitator's ability to answer their (infrequent) questions. Of course, Central High students also turned to each other for help. At South and North High Schools, the students had frequent questions; and whether their facilitators could answer the questions, or direct them to an alternative information source (and get the students to use the resource), also affected student learning. Unfortunately, the South and North High School students rarely took advantage of these resources.

Implications for Theory and Practice

This study supports the position of theorists such as Shale (1990) and Garrison (1989) who contend that distance education, while morphologically different, does not constitute a distinct educational process. The same factors that affect student learning in a traditional classroom also affect student learning in a high school distance education class; that is, learner skills, knowledge, beliefs, attitudes, and course/lesson design.

The study also suggests that responsibility for the quality and outcome of high school distance education courses is shared among all components of the distance education system; the course provider, the high school utilizing the program, and the local facilitators and students who are participating in the course. Specifically, the course provider, instructor, and designers, are responsible for providing effective, efficient instruction in the form of courses that maximize student achievement. This includes designing, developing and providing instruction, materials and activities, that, when utilized as prescribed, result in student mastery of clearly defined objectives. This also includes clear specification of desired student outcomes, required student entry skills (perhaps a specific pre-requisite skills test rather than designation of required pre-requisite courses), instructional materials and activities, a prescribed plan for course implementation, and other student support as required.

The responsibilities of the local school include assuring students possess the pre-requisite entry skills, and supporting utilization of the course as designed by the course provider. This includes fully implementing the complete range of instructional activities in the sequence designed by the course provider. Or, if the school can not implement the course exactly as designed, it must assure that other components in the system can compensate for the instructional elements that were not implemented as designed. Specific school responsibilities include registering (and pre-screening) students, establishing school calendars, bell schedules, and selecting and establishing facilitator availability. These are all factors which contribute, directly or indirectly, to facilitator and student roles and performance. Since two of the schools participating in this study deviated to some degree from the course provider's implementation recommendations (i.e., student pre-requisites, off-air activity block scheduling, and facilitator availability), this may provide evidence that one of the challenges high school distance education course providers will face is getting schools to utilize courses as designed. This is similar to the problems instructional designers have traditionally faced in getting schools to use courseware as designed (Burkman, 1987).

Finally, the study suggests that in addition to course design and school factors, facilitator roles and performance requirements will be defined by the needs of the students themselves. Students who are high on the motivation and willingness continuum but low on the ability continuum may require facilitator support in the form of instructional assistance (if the facilitator has subject area expertise) or encouragement and assistance in using telephone tutor or other external support (if the facilitator does not have content area expertise); whereas students who are high on ability but low on motivation and willingness will require facilitator support to help them stay on task and participate in class activities (Hersey, Blanchard, & Johnson, 1996).

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Form Follows Function: Designing Web Pages to Support Educational Projects

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Curriculum-based telecollaborative projects happen both across and within participating school sites; they have no one geographic location. It is helpful, therefore, to create a central, virtual space for sharing information about project-related activities. Many online project directors use World Wide Web pages for this purpose.

Eliel Saarinen (1873-1950), a Finnish architect and city planner who moved to the United States in the 1920's, was quoted in the July 2, 1956 issue of *Time* magazine as having said:

> Always design a thing by considering it in its next larger context—a chair in a room, a room in a house, a house in an environment, an environment in a city plan. (Tripp, 1970, p. 149)

Saarinen's words convey wisdom to those of us planning curriculum-based educational telecomputing projects that will be supported by Web pages. The "next larger context" for project page design is the variety of *functions* that designers intend the WWW site to serve and support. Project pages should be designed with these functions in mind. Before offering Web documents to an online community, we should answer questions like these:

- Who will be interested in exploring the site?
- What types of information should be available at the site to address different audiences' interests?
- How should this information be presented, so that it is maximally helpful to project participants and/or Web strollers?

Currently, Web page design is addressed primarily in terms of *form* and *content*, rather than function. We consider, for example,

- layout options (i.e., "Should we use frames?").
- overall structure (i.e., "Should the site be one long page with links to subsections or multiple, shorter pages?").
- transfer time (i.e., "How many graphics should I put on this page?").
- browser differences (i.e., "Will *Lynx* users be able to benefit from my site?").
- readability (i.e., "Does this combination of background pattern and text color make the page difficult to decipher?").
- aesthetics (i.e., "Is the combination of colors, items, and spacing pleasing to the eye?").

In this paper, I will suggest that we also consider project-related *functions* as we design WWW documents. Any architect (including Mr. Saarinen) would strongly suggest that "form *follows* function."

Project-Related Page Functions

Let's examine aspects of a few Web-based educational telecomputing projects to illustrate ten different project page functions. More information about each curriculum-based effort is available on the Web, using the either the project URLs provided below or a site containing links to examples of each function. This centralized page function resource can be accessed online at: http://ccwf.cc.utexas.edu/~jbharris/Virtual-Architecture/.

Project Overview

Web sites can serve as succinct **introductions** to the goals and operational structures for educational telecomputing projects.

iEARN's ongoing Rope Pump Project, for example, which brings clean water to villages in Nicaragua in the form of a rope-operated water pump, is described on the project's Web page as follows:

> In rural villages in Nicaragua, many children and adults are subject to disease and death because of lack of access to clean water. Through the Rope Pump Project, we are collaborating with an organization called El Porvenir ("The Future") which worked on small water projects in Nicaragua. Students in I*EARN have raised over $10,000 to fund the digging of wells and the installation of rope pumps in villages where people were drinking from polluted streams or from wells that had been contaminated by dirty buckets being thrown into them. We have received numerous letters from children in those villages, thanking our students for providing the materials (the Nicaraguans provide the labor) for their wells and pumps and describing their lifestyles and

goals. We are in the process of setting up a system whereby students can communicate with children in those villages on a regular basis. (http://www.iearn.org/iearn/projects/pump.html)

The page also provides information on the ages for which, languages in which, and dates that the project has been functioning, along with an E-mail address to use to write for more information.

Project Announcement

Web sites can **announce** curriculum-based projects, inviting participation and providing links to relevant networked resources.

The well-organized and well-detailed announcement for the Boreal Forest Watch project in Saskatchewan and Manitoba, Canada, for example, offers clearly-stated explanations and descriptions of purposes, plans, and collaborators for this ambitious ecology project.

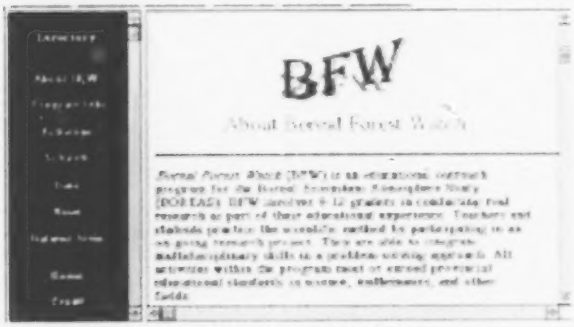

Figure 1. Boreal Forest Watch Project Announcement

As you can see in Figure 1, many aspects of the project can be learned about using its Web site, including descriptions of component activities, information about participating schools, plans for creating the database of observational data, and announcements of upcoming project-related events. There is also an index of similar projects and content-related information on the Web provided for the site's visitors.

Project Instructions

Web sites can provide specific **instructions** to telecollaborators on how to participate in the educational project.

iEARN's excellently organized Learning Circle global classroom projects (http://www.iearn.org/iearn/circles/lc-home.html), for example, are supported by a hypertextually linked set of carefully crafted and information-rich Web pages, which provide specific step-by-step instructions for project participation. A small section of the main page at this site appears in Figure 2. Please note the many active links to documents supporting each stage of project work.

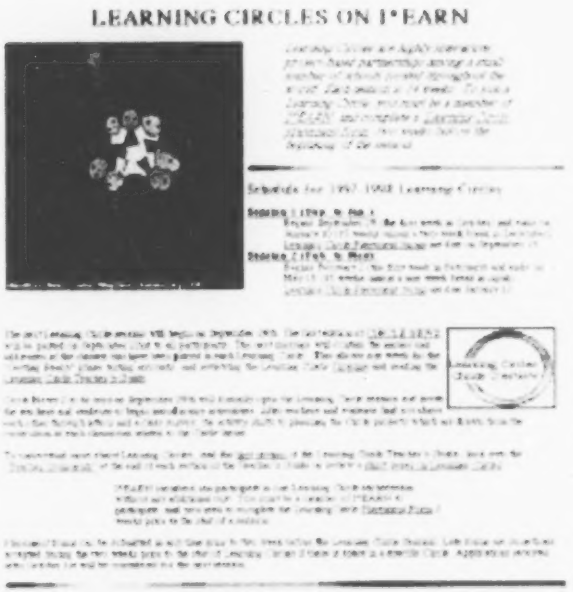

Figure 2. Instructions for Participation in I*EARN's Learning Circles

The page also contains information on joining I*EARN, links to conferencing spaces in which project partners communicate, links to custom-designed Web page publication aids, and a chronologically organized timeline for the current session of Learning Circle telecollaboration.

Information Repository and Exchange

Web sites can serve as virtual places for project participants to **exchange information**.

KIDLINK's long-term Multi-Cultural Calendar database creation project site (http://www.kidlink.org/KIDPROJ/MCC/) cross-indexes student-written depictions of hundreds of holidays and festivals from around the world.

Figure 3. KIDPROJ's Multicultural Calendar Project Main Page

As you can see in Figure 3, the holiday descriptions are accessible by month, holiday name, country, author, and user-supplied keywords. A World Wide Web-based form is also available at the site, so that new entries for the holiday

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database can be submitted more easily. A portion of this form is included in Figure 4.

Figure 4. KIDPROJ's Multicultural Calendar Holiday Entry Form Excerpt

Context for Project-Related Communication

Web pages can be co-constructed by project participants, creating an open-ended form of **multimedia communication**.

The Electronic Emissary telementoring project (http://www.tapr.org/emissary/), which "matches" volunteer subject matter experts with students and teachers interested in inquiry-based learning in the experts' specializations, has seen a few electronic teams co-create Web pages to facilitate their virtual interactions. This is especially effective when pictures or diagrams need to be concurrently viewed, and can be supplemented by realtime audio/video interaction using *CUSeeMe*.

For example, a meteorologist working for the National Center for Atmospheric Research in Colorado helped a sixth-grade class in Texas learn about atmospheric science, in part, by suggesting an experiment that required the assembly of a device that would help them to "measure radiative processes." The scientist posted a picture of the device on the common page, as a beginning to an ongoing, multimedia discussion of the results that the planned experiment yielded.

Project Support

Web sites can serve as organized collections of **project-related resources**.

CoVis' rich and well-organized site (http://www.covis.nwu.edu/) offers a plethora of materials that can be used by participants as they explore geosciences in telementoring contexts, "learning through collaborative visualization."

Figure 5. CoVis Project Main Page

Figure 6. Hobart-Malang E-Mail Project Header

The key to making project support sites maximally useful to project participants is to organize the materials offered for quick and efficient access. CoVis' main menu, shown in Figure 5, reflects the care and thought that project coordinators have put into the functionality of the project's Web site.

Project Chronology

Web sites can present chronologies of **past and ongoing project work.**

The rich and varied nature of the Hobart - Malang Electronic Mail Project (http://www.tas.gov.au/fahan/Compute/indo.html) is excellently reflected in the project's detailed and visually appealing Web site.

This multi-year, multi-class, multifaceted, emergent keypals project involved Year Four students in Hobart, Australia and Malang, Indonesia, who wanted to learn about each other's cultures, countries, and ways of life. Many topics were discussed, many sets of materials were exchanged, and many learning products were created in the course of the exchange. Much of this is available for perusal at the site, richly illustrated with children's works, photographs, project artifacts, and descriptive text. Hints of the incredible variety represented can be discerned by looking at a portion of a list of active links to project-related materials, as pictured in Figure 7.

Figure 7. Hobar-Malang E-Mail Project Partial Page Contents

Showcase of Participants' Works

Web sites can provide viewing space to share project **participants' creations.**

Marian Herman's International Peace Museum (http://www.ih.k12.oh.us/ps/peace/), is a thematic project for students in kindergarten through grade 3.

Figure 8. International Peace Museum Virtual Entrance

The project invites young children to "think about peace and the importance of peace," as its creator has said.

This Web project and the museum that it creates might actually be able to affect the future of the world in some small way. It's an exciting thought. (http://www.hmco.com/hmco/school/projects/peacemuseum.html)

Participating students in different schools from around the world are asked to read books about peace, discuss the ideas they encounter in class, then "decide what peace means to them," writing a statement or poem and illustrating it. These creations are then posted at the Peace Museum site, but in a creative and educational way. Contributions from other classes are organized into wings of the virtual museum, as seen in Figure 9.

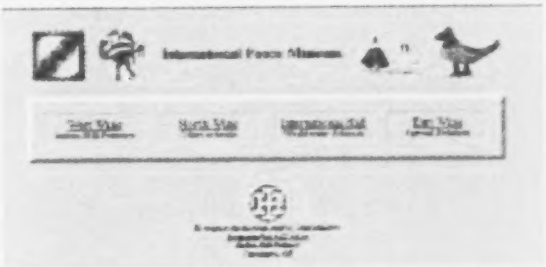

Figure 9. International Peace Museum Map

In the North Wing, for example, are links to collections of peace works from other schools in the United States:

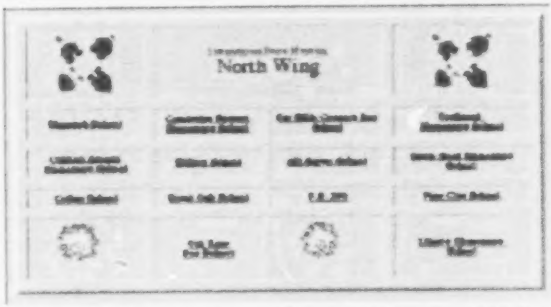

Figure 10. International Peace Museum, North Wing

Students at the Manaugh School in Cortez, Colorado, for example, created a mural and poem that illustrates the potential power of thematically-organized projects such as these:

We at Manaugh have a dream...
That Native American, Hispanic, Hawaiian, and Caucasian kids can all play together on the same monkey bars.
That all kids are treated equally.
That no one shall fight anymore.
That everyone can share friendship, harmony and peace.
Freedom is all that matters.

Mrs. Herrick's Reach Class, Cortez, Colorado USA
(http://www.ih.k12.oh.us/ps/peace/cortez/cortez.htm)

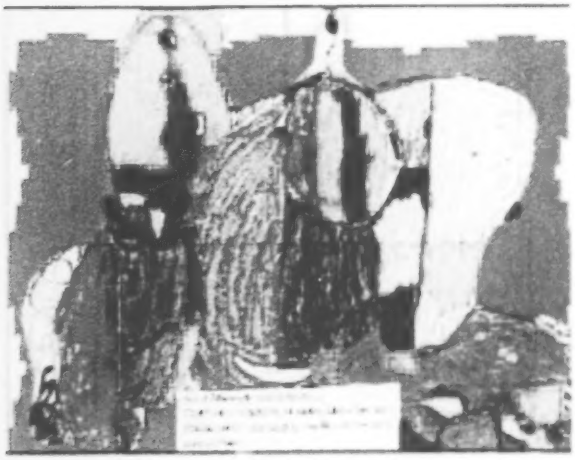

Figure 11. International Peace Museum, North Wing Exhibit

Project Center

Web sites can serve as **multipurpose centers**, combining several of the project-related functions listed above.

The home page for Noelle Kreider's Read to Write Project (http://www.itdc.sbcss.k12.ca.us/projects/kreider/index.html), an effort to inspire students to immerse themselves in particular literary genres first by reading, then by creating and publishing that type of writing, shows a selection of current, future and past topics for exploration.

Yet once one of these options is selected, we see how engaging lanugage, white space, and well-placed illustrations can be used to make a resource-rich project center quite easy to navigate. The main page for the Historical Biographies section, for example, illustrates well how many of the page functions mentioned earlier in this section can be combined to create an information-rich, facilitative, multipurpose "virtual center" for an educational telecomputing project.

As you can see by the list of topics in the left-hand menu in Figure 13, this project's schedule, participants, online discussions, student works, resources, registration, and instructional suggestions are easily accessible from this well-presented page.

Figure 12. Read to Write Project Main Page

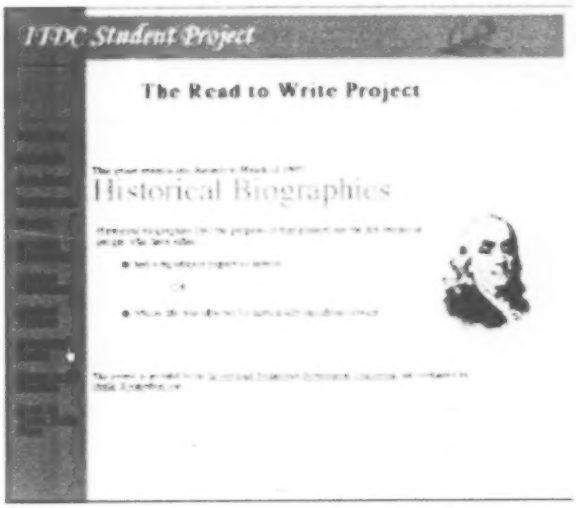

Figure 13. Read to Write Project Historical Biographies Menu

Project-Spawning Service

Web sites can offer **electronic services** that can help to initiate new curriculum-based telecomputing projects.

A growing number of services that help teachers and students locate information and interpersonal contacts with which they can begin new projects are now available on the

Web. Notable among these are keypal and global classroom partner locators, such as:

- the Intercultural E-Mail Classroom Connections service (http://www.stolaf.edu/network/iecc/)
- eMail Classroom Exchange (http://www.iglou.com/xchange/ece/index.html)
- Classroom Connect's Teacher Contact Database (http://www.classroom.net/contact/)
- Keypals International (http://www.collegebound.com/keypals/)
- Mighty Media's Keypals Club (http://www.mightymedia.com/keypals/)
- Dave's ESL E-Mail Connection(http://www.pacificnet.net/~sperling/guestbook.html)
- and Virtual Handshake (http://ananke.advanced.org/3174/), shown in Figure 14, which offers interpersonal connections in seven different languages: English, Spanish, French, German, Afrikaans, and both SJIS and rooma Japanese.

Figure 14. Virtual Handshake Language Selection Menu

Curriculum-based project planning tools are beginning to show themselves online, also. Notable among these is Pacific Bell's Filamentality (http://www.kn.pacbell.com/wired/fil/), a well-executed instructional design tutorial that helps its users to create WebQuest-like teleresearch sites to be used for instructional purposes. In the words of its witty creator,

What Exactly Does this Filamentality Do?

Maybe it doesn't slice, dice, or chop, but Filamentality does blend your learning goals with the outrageous resources available on the Web. How does Filamentality do it? By guiding you through the complete instructional design process. Okay, okay, we'll tell you in real English: Filamentality works its magic with online ideas to help you pick a topic (if your brain is drained), Mentality Tips for things like searching the Web, a bunch of "fill-in-the-blanks" to gather good Internet sites, and interactive pages that help you shape your ideas around whatever specific goal you have, and then, presto change-o, gives you your very own Web page on the Internet.http://www.kn.pacbell.com/wired/fil/)

Sound too good to be true? If so, why don't you go to Filamentality's site and check out the resources there for yourself?

The *Next* Next Larger Context: Purpose

Hopefully, the ten Website functions explained and illustrated above will help you to allow function to drive form as you design Web pages to support current and future educational telecomputing projects. I would be remiss, however, if I did not urge us all to continue to follow the pattern of Saarinen's sage advice by considering function in terms of its next larger context: purpose. For, as Norbert Wiener wrote in 1954 in *The Human Use of Human Beings*,

> There is one quality more important than "know-how"...This is "know-what," by which we determine not only how to accomplish our purposes, but what our purposes are to be. (Tripp, 1970, p. 524)

In the context of educational activity design, the *next* next larger purpose always refers back to curriculum-based content and process goals. Telecomputing is not, and should not be treated as, another curriculum. Instead, it can serve existing and emerging teaching/learning goals in rich, authentic, and forward-thinking ways.

Acknowledgements

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DIVERSITY

Section Editors:
Inés Márquez Chisholm, *Arizona State University West*

Diversity. Is it another educational fad? Is it exclusively about and for minorities? Is it about global awareness? Or is it just another politically correct catchword? What exactly is *diversity*? And why should the SITE 1998 Annual have a section on diversity?

Defining diversity is like defining humanness. Everyone knows what it is, but everyone explains it differently because they focus on a different aspect. Thus there are as many definitions of diversity as there are books on the topic. Perhaps diversity is so difficult to define because it is about the nature of humanness.

Many equate diversity with differences in inherited racial and ethnic attributes. However, this perspective portrays a very limited view of diversity. Humans are complex, dynamic entities who differ from each other in numerous ways. We differ in our educational background, geographic location, income, gender, sexual orientation, age, physical abilities, marital status, parental status, and religious beliefs. In addition to cultural and socio-economic differences, we also differ in how we prefer to learn, how we organize ideas, and how we view the world. Given the countless differences among people, it is not surprising that people often misunderstand, fear, mistrust, and discriminate when they come into contact with those who are different from themselves. These emotional and social barriers result in academic inequity, economic favoritism, emotional devastation, social dissonance, and human ignorance.

As our world experiences increasing demographic changes, the need for justice, equity, and harmony become acute. Diversity will not disappear or be dissolved in the great melting pot that makes everyone *the same*. Similarly, social inequities will not disappear unless there is intercultural understanding that leads to social activism for equity. Because human diversity is a valuable resource that strengthens society and enriches individual lives, educators have a growing concern with diversity, multiculturalism, global awareness, and social advocacy.

So why a separate section on diversity in this Annual? To assume that all people approach technology in the same way, have the same perceptions about technology, or have the same access to it is to ignore human diversity. The expanding use of technology in education, across disciplines and academic levels, makes research on diversity and instructional technology imperative. Moreover, by placing papers on diversity into a separate section, the Annual demonstrates not only a valuing of diversity, but also a clear interest in diversity and technology issues. Though diversity permeates much of what we do as educators, without a separate section devoted to diversity much of that knowledge would be diffused and subsumed.

The papers in this section address diversity from a broad, encompassing perspective. The first two papers focus on issues of diversity and technology access. Chisholm, Carey and Hernández's *University Minority Students: Cruising the Superhighway or Standing at the On-Ramp* explores access to technology among minority and low SES university students. This paper presents disconcerting national statistics on technology access and discusses on-going research. Their study stems from collaboration between the faculty researchers and university administrators. The second paper, *Gender Equity Model: High School Female Students and Technology Awareness* by Beasley, Wark, and Zimmerman, examines female students access to technology. These authors delineate a program model for developing career awareness among high school girls through the integration of technology throughout the program. They report their findings after their first year of successful implementation.

The third, fourth and fifth papers convey a global perspective of diversity and technology. In their paper *An International Comparison of Computer Perceptions, Attitudes and Access*, Chisholm, Irwin and Carey submit preliminary findings from an on-going international study of university students. This paper summarizes results from a questionnaire administered in China, Ghana and the United States and provides some cultural and educational implications of their findings. The next paper, *Using Live Teleconferences to Promote Diverse Perspectives* by

Cynthia Anast Seguin, demonstrates how live teleconferences between geographically distant schools can promote multicultural knowledge and cross-cultural understanding. This project linked middle school students in Juneau, Alaska with students in Burlington, Kansas. Collaboration between school teachers and university faculty made this project feasible. The fifth paper, Julie Qiu Bao's *A Multimedia Comparison of Value Orientations between Chinese and American Elementary Textbooks*, examines the cultural values conveyed by Chinese language arts and American social studies textbooks. The author discusses how explicit or implicit values education reflect pervading moral principles and national beliefs. In addition, the author provides suggestions on using presentation software in disseminating research findings.

Like Bao, Ryan, Sweeder, and Bednar investigate values education. Their paper, entitled *Technology and the Moral Sense: Re-Wiring Moral Education*, identifies four universal moral values: sympathy, duty, fairness and self-control. The authors provide an overview of current trends in moral education and suggest how educational technologies and moral education can be integrated.

The last two papers approach diversity from the standpoint of individual differences in teaching and learning. Norton and Sprague in *Teachers Teaching Teacher: The Belen Goals 2000 Professional Development Project* document a district plan for teacher technology education that follows a teachers-teaching-teachers model. The project called for collaboration between a university faculty member and the school district personnel. The authors present the results of this project as measured by a pre- and post-test questionnaire. Similarly, Nancy Wentworth in *Technology Inservice: A Powerful Change Force* discusses a technology inservice project that followed Michael Fullan's eight basic elements of change. This inservice project was a collaborative effort between a university teacher education program and a public junior high school. Wentworth relays program results based on data from interviews, journals, and logs.

The scope of these papers mirrors the complexities and magnitude of diversity. As educators continue to explore the convergence of technology and diversity, and as we begin to translate research findings into classroom practices, all our students will be better served.

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University Minority Students: Cruising the Superhighway or Standing at the On-Ramp?

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Anthony Hernández
Arizona State University West

We entered the century with pencil and paper; we leave it with computers able to figure thousands of times faster than the human brain.
—Carol Sue Fromboluti

Universities can no longer remain aloof, ivy-covered towers of erudition and elite stature. Shrinking budgets, changing student demographics, and public demands for accountability have altered the traditional academic climate. Institutional response to the changing social and economic pressures has led to paradigm shifts, realignment of university missions, and instructional transformation. Among the instructional transformations embraced by many institutions is the incorporation of information technology as both a mode of instructional delivery and as a means for student learning and performance.

The prevalent movement towards increased use of information technology is not, however, primarily aimed at improving the quality of higher education. In reality, our institutions have found that they must turn to "information technology to stay in business" (Barone, 1996, p.28). Research suggests that instruction delivered through computer or distance learning is not only economically effective, but also instructionally effective (Castellan, 1993). To ignore or avoid technology at our institutions is to "drown under its weight" (Alvarez, 1996, p. 26)

Technology in Higher Education

In today's competitive market the use of electronic information resources is becoming a distinguishing attribute of institutions that pride themselves in offering the highest academic standards (Ringle, 1996). In fact, the presence of information technology is a critical asset in recruiting quality students and faculty, as well as in attracting external funding. Understandably, university students and their parents seek quality and low-cost education. At the same time, outstanding faculty are drawn to those institutions that provide them with the electronic tools for communication, information and research. In turn, it is the reputation of an institution's students and faculty that ultimately attracts external funds to support a university's growth and development.

Consequently, technology plays an increasing role in course design, delivery, and content. In 1995, between 20 to 30% of instructors in higher education used some form of instructional technology in course delivery (Goggin, Finkenberg, & Morrow, Jr., 1997). The number of college classes that use electronic mail rose from 8% in 1994 to 25.0% in 1996 (Green, 1996). By the same token, in 1996, about 9% of all college courses used WWW-based resources to support instruction (Green, 1996). In addition, according to Tapscott (1996), there are over 2,000 courses currently available on the Internet. Not surprisingly then, approximately 31% of all institutions of higher education have a computer competency graduation requirement and one in six institutions requires or strongly recommends that students purchase a computer (Cartwright, 1993).

Casualties on the Superhighway

While computers and the electronic superhighway are transforming higher education, university and college campuses are encountering a changing student population. Fewer than half of the nation's undergraduates are traditional 19 to 22 year olds (Cartwright, 1993) and minority student enrollment increased from 15% of all students in 1976 to 23% in 1993 (NCES, 1996c). These students bring with them a rich array of experiences and knowledge about the world. However, those experiences and knowledge may not have included the computer and multimedia technology.

Many students from culturally, racially and ethnically diverse backgrounds, as well as nontraditional students, come to higher education with fewer technology experiences and less computer expertise than their majority counterparts. As Krupar (1996) points out, a large

proportion of these students is "technophobic" and lacks the necessary background and skills to fulfill computer-related assignments. These students find themselves unable to meet faculty and institutional performance expectations and to take full advantage of their university education.

National data bear out the differences in computer access and experiences among our students. As of June 1996, approximately 40% of all American households had computers, 21% of these had CD-ROM drives and 18% had modems (Famighetti, 1997). Thus, contrary to popular belief, most households do not have computers and fewer still have Internet and e-mail capability. Further, the number of computer-owning households is unequally distributed across race and ethnicity. Whereas 49.4% of White undergraduate students have computers at home, 27.0% of African American students and 27.3% of Hispanic students do (NCES, 1996a). Of those with home computers, only 36.4% of White students, 41.3% of the African American students, and 31.4% of the Hispanic students had a fax or modem (NCES, 1996a). Even more revealing is that 48.7% of the White population use computers at work, but 36.2% of the African Americans and 29.3% of Hispanics have that opportunity (NCES, 1996b).

This inequitable access to technology leads to information-poor segments of our society. Robert Bauchspies (1996) defines the information poor as those who exhibit one or more of the following characteristics:

- Illiterate
- Unable to determine their information needs
- Unable to discern value or relevance of information to their needs
- Unable to develop information seeking strategies
- Unable to afford access to information
- Unable to access information due to cultural or physical barriers

Bauchspies' definition highlights the urgent need to increase access to information technologies for those who either cannot afford the hardware and software costs for entering the Superhighway or who have been prevented from access through cultural inequities or physical barriers. Our institutions of higher education cannot ignore their obligation to prepare students who are literate professionals. In our increasingly technological society, literacy includes technological literacy.

The question of equitable access to technology and the superhighway becomes an ethical and academic issue. As Krupar (1996) states, more and more faculty require students to correct their spelling and grammar, use graphic presentations, and use several data bases in researching topics. Universities often function as if all traditional-age students are computer literate, can afford to purchase a computer and value computers (Krupar, 1996). However, low socio-economic families are less likely to purchase computers. Black and Hispanic households continue to have an average income that is approximately 60 % of that of white households (NCES, 1997). Unwittingly, institutional expectations for technological competence and computer ownership may lead to many causalities on the information superhighway.

Though there is much information about the inequities in computer access in grades K-12 (Coley, Cradler, & Engel, 1997), there seems to be very little information on this issue in higher education. One study that does explore this issue is an informal survey by Mendoza (1995) of students enrolled in a composition course. Mendoza found that the 25% of the minority students who owned a computer considered themselves middle class. Of the 75% who did not own a computer, almost half identified themselves as lower-income. However, the small sample size in this study limits generalizability.

Hypotheses and Instrumentation

To gain an increased understanding of access issues, three researchers began to explore the question of accessibility to existing campus technology by low socio-economic, nontraditional, and minority students. They posed the following questions:

- Do nontraditional, low socio-economic and traditionally underrepresented college students in higher education have the same access to computers and information technology as traditional majority students?
- Do nontraditional, low socio-economic and traditionally underrepresented college students in higher education have the same computer training and information technology background as traditional majority students?
- What factors are associated with access and frequent use of information technology?
- Do nontraditional, low socio-economic and traditionally underrepresented college students in higher education have the same attitudes towards computer technology as traditional majority students?

To answers these questions, one of the researchers created a multiple-choice questionnaire during the summer of 1997. During Fall 1997 the three researchers reviewed the instrument and revised it. In addition, the staff of our Information Technology office, the Associate Vice-Provost for Extended Instruction, and members of the Information Technology Advisory Committee reviewed the instrument and provided suggestions. The researchers incorporated their suggestions into the instrument.

The questionnaire currently has seventy-two multiple-choice items. Several items on this questionnaire also allow open-ended responses. Twelve items collect information on gender, race, ethnicity, and socio-economic background. Some of these items gather information on family background. For example, one item asks respondents how long their family has lived in the United States. Another item asks if the respondent is the first person in their immediate

family to attend college. Other items ask for direct information about the respondent. For instance, one item asks the respondents if English is their native language. Another item asks the primary source of financial support for their education. Yet a third item asks if they currently work full or part-time while attending school.

Nineteen items address computer access both on- and off-campus. Nine items focus on hardware access. For example, students are asked whether they use computers on campus and how frequently, whether they have a computer at home, the type of computer owned, and if they use a computer at work. There are also questions regarding on-campus multimedia facilities and their use. Four items examine computer software access. These items include questions on the types of programs used at the university computing center and at the campus library. An additional six items center on Internet and e-mail access. These items ask students if they have e-mail or Internet access at home, their frequency of use, and their purpose in using the Internet.

Twenty-three items on this instrument explore students' current computer use. Thirteen of these items ask for types of software applications used regularly, their frequency of use, and the purpose for using the software. Ten items examine classroom and course use of computers. For example, students will indicate whether their courses and program of study require computer use and whether their instructors use computers. In asking students if instructors use computers, the researchers hope to glean information about students' perceptions of faculty computer competency and faculty modeling of information technology use.

Another set of questions on the survey probes computer skills and training. To illustrate, students self-report their degree of computer knowledge, confidence, and number of courses about computers. Students will also indicate if they have taken courses over the Internet.

A final set of questions explores students' computer perspectives. Sample questions include whether respondents believe that all students at our institution have the same opportunities to use technology, whether computers are essential to their academic life and professional life, and whether scholarships should provide for computer purchase.

Sample

Arizona State University West is an upper division university with some 5,000 students enrolled in junior, senior or graduate level courses. Because ASU West does not offer freshman and sophomore classes, many of our students first attend one of the local community colleges. ASU West students enroll in Bachelor's and Master's degree programs in five academic areas: the College of Arts and Sciences, the School of Management, the College of Education, and the College of Human Services, as well as the Division of Collaborative Programs. Our students are largely female, 64%, and nontraditional, 65% are 25 years or older. Most, 63%, are also part-time students.

During the third week of the Spring 1998 term, a stratified random sample of 500 Arizona State University West undergraduate and graduate students will receive and respond to the survey. Since larger numbers of ethnic and racial minority students on our campus tend to enroll in specific degree programs, such as Bilingual Education, Global Business, Women's Studies and Social Work, stratification of the sample by program areas and ethnicity will ensure that a significant number of minorities on campus are included in the sample.

Procedure

Inasmuch as Arizona State University West is currently expanding the number of asynchronous course offerings, providing faculty development in Web page creation for distance learning, and preparing a university-wide five-year strategic plan, the researchers approached the administration with the idea of collaborating in a campus-wide survey. Consequently, the ASU West Office of Institutional Planning and Research is providing staff support and absorbing the cost of survey duplication.

During the third week of the Spring 1998 term, the researchers will administer the survey to students in selected classes from each of the five academic areas on campus. These classes, selected on the basis of enrollment, will include a racially and ethnically diverse student population. The Office of Institutional Planning and Research will then data process the responses and the three researchers will analyze the data.

Implications

Collaboration between university faculty and administrators can yield valuable information for institutional long-term planning, while adding to our knowledge base on technology and diversity. This study demonstrates how faculty scholarly endeavors can provide answers to essential administrative questions. The researches will widely disseminate the results of this survey across our campus. They will share the findings of this study with the Provost, the Vice Provosts, Information Technology, the Advisory Committee for Information Technology, the Campus Environment Team, the Office of Student Affairs, the Deans of each of our colleges, the Academic Senate, the Senate's Student Issues Committee and the Strategic Planning Committee. The results will help shape the future of technology use on our campus.

In addition, this study will serve as a basis for a national study on technology among diverse university populations. National data will offer a broader view of the current situation and help college and university educators discern the issues more clearly. The researchers believe the findings will provide information for administrators and faculty across the United States. The findings will help in planning for multimedia integration, distance learning, and

technology policies that will provide broad access to information technologies. Unless we know the problems, we cannot begin to address them. Furthermore, unless colleges and universities recognize the severity of the problem, they will unwittingly contribute to the academic failure of historically underrepresented college students (Krupar, 1996). Without adequate information, our institutions will perpetuate inappropriate computer pedagogy and obstructive administrative policies.

Ultimately, the ability of higher education to provide quality education for all students in a high-tech environment is a matter of planning for technological equity. Increasingly institutions of higher education allocate part of their limited financial assets to expanding and upgrading their multimedia technology resources. Clearly, technology will continue to play a critical role in higher education during the next century (Ward, 1994). As our institution cruise along the Superhighway, we need to make room for those who are standing at the on-ramp. To fail to do so is to abandon a growing portion of our student body to becoming the technologically illiterate.

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Gender Equity Model: High School Female Students and Technology Awareness

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A powerful force in today's technology field addresses such issues as equitable educational environments, student motivation, and systemic approaches to decision-making processes involving secondary, post-secondary, and career awareness. The current Gender Equity Model evolved from these critical issues based on findings such as those from the *AAUW Report Executive Summary* (1992):

1. Girls from low-income families face particularly severe obstacles to academic success. Socioeconomic status, more than any other variable, affects access to school resources and educational outcomes.
2. Test scores of low-socioeconomic-status girls are somewhat better than for boys from the same background in the lower grades, but by high school these differences disappear. Among high-socioeconomic-status students, boys generally outperform girls regardless of race and ethnicity.
3. Too little information is available on differences among various groups of girls. While African Americans are compared to whites, or boys to girls, relatively few studies or published data examine differences by gender and race and ethnicity.
4. Differences between girls and boys in math achievement are small and declining. Yet in high school, girls are still less likely than boys to take the most advanced courses and be in the top-scoring math groups.
5. The gender gap in science, however, is not decreasing and may, in fact, be increasing.
6. Even girls who are highly competent in math and science are much less likely to pursue scientific or technological careers than are their male classmates. (pp.3-4).

With these findings in mind, a model for gender equity in a rural Appalachia school system is approaching its second year of implementation at the high school level. This model focuses on equity issues, student motivation, and nontraditional course work. In addition, it addresses career awareness for females, including a strong emphasis on technology and the sciences. Specific objectives are the following:

1. To establish higher expectations of female students in both academic and vocational classes.
2. To implement career exposure activities that provide female students information on nontraditional careers.
3. To provide women students with a curriculum which integrates academic and work experiences.
4. To provide female students with career and social guidance and counseling.
5. To evaluate female students' progression through motivational and attitudinal assessments.
6. To include multiple resources in creating a gender equity program.

Selection Process and Qualifying Criteria of Participants

The selected participants demonstrated interest in such areas and courses as Technology/Manufacturing, Principles of Technology, and Integrated Systems Technology. These courses enable students to work as individuals and in teams on designing and constructing projects using plastics, pneumatics, hydraulics, robotics, electronics, metals, metal testing, foundry, welding, and technical drafting. This course work also emphasized computer skills throughout. Female participation and enrollment is generally low in these specific courses (i.e., 10% or less). Other classes viewed as important in this selection process include science courses with a focus on technological labs using electronic evaluations and experiments, and various agricultural and horticultural fields.

Another factor considered in the selection process includes a focus on a targeted population of females. This targeted population consists of those students who are from economically and socially disadvantaged backgrounds, as well as students who possess future expectations and goals for a post-secondary education.

The Three Stages in the Gender Equity Model

The Gender Equity Model funded through a feder... grant, is in its second year of implementation. The mod... is composed of three distinct stages for the enhancement of courses and careers in nontraditional fields for females. The first stage requires career interest surveys and assessments, a pre-test on school interests and motivators, and the forming of individual student advisory committees. The second stage involves activities and a ropes course for the enhancement of team activities in problem-solving and decision-making processes, goal-setting, team building, and communication processes. The third stage requires hands-on job experiences and placements requiring a minimum of fifty hours work with local employers in the interested, nontraditional fields of study for females.

Stage One

In conjunction with additional goals and objectives within this particular high school setting, this equity program assisted in creating a complete computer lab that includes an entire course and a career counseling program. The career and counseling center will assess student interests and potential in a wide range of courses and careers. Student schedules will be applied to match students' academic needs and expectations. To provide smooth transitions between grades, the center will also focus on assessments from middle-school course interests and data. The equity program supplied career software to the middle schools that feed into the targeted high school. The middle-school software matches that of the high school, except it is on a middle-school level and in a simpler format. Students at all levels learn to utilize computer skills in the computer lab setting as personal student data and assessments are collected.

In order to implement a usable and friendly program, first-year female students participating in the equity program viewed various programs prior to the purchase of the current program. These students gained extensive experience in a variety of career assessment programs. Currently, computerized surveys assess participants' career interests as they explore and learn about various nontraditional careers for females. This software program also offers extensive data on needed secondary and post-secondary course work. In addition, information is available on universities offering such degrees, the need for individuals with these degrees, salaries, and available scholarship money. This information becomes part of the criteria for students as they consider future choices and career paths with counselors and parents.

A second part of the initial stage in the equity program involves an assessment on student motivation and attitude toward school. Subscales include motivation for schooling, academic self-concept, student's sense of control over performance, and student's instructional mastery. This attitudinal and motivational assessment serves as a pre-test and as a post-test of the participants.

In addition to these preliminary activities, the program assigns students to advisory committees which can consist of school guidance counselors, teachers, parents, business mentors, equity and school partnership directors, and the student.

Stage Two

The second stage of the model promotes activities and initiatives to enhance student motivation, morale, and self-confidence. Activities in socially-arranged groups range from student luncheons, helpful videos related to nontraditional careers and course work, team building games and activities, to a ropes course. Specific goals of these activities relate directly to problem-solving and decision-making processes, goal-setting, team building, and communication processes.

The literature on group interactions and group dynamics, which are considered a vital part of the growth in a group, provides support for these activities and their outcomes (Bertcher, 1979; Bertcher & Mapel, 1977; Dye, Gardner, Underwood & Clark, 1987; Fraus, 1979; Griffin & Patton, 1971; Kamii & DeVries, 1981; Reeves, 1970). Shaw (1981) states that the results of group interactions include higher levels of energy focused on goal attainment, along with more motivation to achieve group goals. Shaw explains that higher levels of trust are created when group interactions occur, causing group cohesiveness. Motivational factors continue to be stressed as a vital component of learning experiences and the acquisition of knowledge within a social context (Bandura, 1986). According to Cartwright (1968), other positive outcomes of group interactions are effective group interaction involving decision-making and group problem-solving processes, greater participation, and higher self-esteem. Ancona, Kochan, Scully, Van Maanen, and Westney (1996), refer to group decision-making as advantageous over decisions made by individuals, particularly in today's competitive world. Advantages include greater access to information and knowledge within a group of individuals, the enhancement of coordination among the various parts of the group, and the establishment of a communication network to facilitate problem-solving. As these outcomes relate to the specific program objectives of creating an awareness and involvement in nontraditional roles for the female participants, the authors assess them through the motivational and attitudinal tests, along with qualitative data.

Stage Three

The third and final stage of the model requires hands-on job experiences and placements requiring a minimum of fifty work hours with local employers in the nontraditional fields of study for females. The majority of these placements promote knowledge and application of various technology skills in a wide range of fields such as drafting,

architectural landscaping, the formation of one's own business, and several work experiences in technological communication.

School Staff and Community Awareness

Another component of this equity model incorporates the utilization of various ommunity resources including local businesses and employers. Through this partnership, school staff receive professional development in such topics as gender and technology issues; integrated teaching, learning, and motivating through the use of computers; and the use of newly-purchased software and technological hardware. Administrators, counselors, and teachers have been active participants in this staff development. Community awareness is enhanced through the communication and involvement of students working in the community and with local businesses.

Continuous Research on the Equity Program

Following the first year of implementation of this model, results were analyzed through both quantitative and qualitative methodology. Findings from qualitative data (through student presentations and interviews) reflected a high success rate on career awareness and self-confidence in relation to the attainment of set goals. Several of the high school seniors made definite decisions, following their experience, to pursue a post-secondary education in the areas of their personal nontraditional experiences.

Quantitative data reflected improvement and gains in various areas, as obtained through the *School Attitude Measure (*American Testronics, 1990*)*. Analyses of this data showed the ninth grade class demonstrated the greatest gains in overall school attitude, specifically in the first subscale which focuses on motivation for schooling. This subscale contains statements concerned with the student's motivation for working hard in school, desire to perform competently in school, and the student's perception of the importance of school and how it relates to future plans. Tenth grade scores indicated improvement in both academic self-concept, performance and reference based abilities. These scales assess a student's feelings about school performance and confidence in academic ability. In grade twelve, greater gains were shown in a combination of two areas, academic self-concept performance based and the sense of control over performance. The sense of control subscale measures the amount of control a student feels she has over school outcomes. General components include willingness to take responsibility for school outcomes, self-reliance, and independence in school. Overall, across all grades and subscales, 61% of the female participants demonstrated an improvement between the original pretest and posttest scores.

This equity model program is beginning its second year of implementation. The authors will continue to conduct research on many of these same students, along with the new participants in the program. In addition, research will include interviews and surveys conducted on the graduating participants as they continue their education on a post-secondary level in a nontraditional career for females.

Future Use of Equity Programs

Due to the newness of research on such programs, it is difficult to predict the outcomes that each individual experiences and will experience in the future, but the analyses of this model suggest that equity programs, such as this one, are in great need and demand within our educational system. This model incorporates equity issues with nontraditional career decisions through technology awareness and discovery. As many participants enter, continue and graduate from the program to pursue education and careers in the various nontraditional fields for females, additional findings will emerge from the program.

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An International Comparison of Computer Perceptions, Attitudes and Access

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As in many cross-cultural contacts, the importation of technology into another society often creates initial cognitive dissonance, disrupts established behavior, and steadily introduces new patterns of response and organization. As a cultural artifact that expresses the culture of its creators, the computer organizes knowledge, reshapes work, changes learning environments, and expands information access in ways that mirror western heuristics and logic. Tallah (1996), noted a two-way cultural infusion "whereby the technologically rich nations draw from and inject into the societies of the less endowed" (p. 2). Thus the introduction of computers, especially into non-western and third world countries, will likely affect changes in interpersonal behavior, communication, and education (Darr & Goodman, 1993). The result of these changes is, at best, an unsettling co-existence in developing nations of the indigenous culture and the imported scientific culture (Yakubu, 1994).

Nevertheless, "one cannot talk about development without talking about computers" (Darkwa, 1996, p. 4). Computer literacy is vital in the effort to participate in and benefit from the global exchange of information, trade, and technology. Developing countries face a myriad of problems compounded by the issues of need and accessibility. Those nations at the periphery of world technologies must enhance "their ability to access, produce and use information as full and equal participants of the global community" (Tallah, 1996, p. 1). By implication, their competitiveness on the world market is increasingly dependent on computers and communications technology.

The acquisition of computer technology is, nonetheless, a massive financial burden. The dependence on western-made hardware, software and expertise keeps third-world nations with fragile economies economically subservient (Dixon, 1995). The acquisition of technology will require significant amounts of capital and technical skills, both meager commodities in most developing nations.

By the same token, social, cultural, and political factors influence how computers are perceived, used, dispersed, and experienced. Given the dependence on wealthier nations for hardware and software, as well as the computer's intrusion into traditional socio-cultural patterns, attitudes and perceptions toward computers in developing nations may be ambiguous at best. Moreover, the level of exposure to and experience with computers will likely influence individual perceptions and attitudes.

Research suggests that negative attitudes and unfavorable perceptions of computers may adversely affect computer literacy (Chen, 1986; Marcoulides, 1988). Similarly, limited computer experiences are related to computer anxiety and lack of confidence in computer use (Chen, 1986; Huang, Waxman, & Padron, 1995). Given the significant role of technology in national economic development, we embarked on an interdisciplinary investigation of attitudes and perceptions towards technology and technology training among college freshmen in China, Australia, Ghana, Mexico, Puerto Rico, and the United States.

This paper presents preliminary findings from China, Ghana and the United States. Data on the other participating countries in this study will be reported at a later time. Within this paper, the authors discuss the implications of their study for cross-cultural technology training and education. In addition, the authors draw conclusions based on this preliminary data regarding the development of technological competency within the framework of computer culture and national culture.

International Comparisons

In 1996 the People's Republic of China had a population of over 1 billion with 67% of its population between the ages of 15 and 64 (CIA, 1996). Mandarin is the official language, but seven distinct dialects and several minority languages are also spoken (CIA, 1996). Between 1978 and 1994 the annual economic growth averaged 9.4% (Jianguo, 1997). Yet in 1994, China had an external debt of $92 billion (CIA, 1996). Under Deng Xiaoping, national educational reform tried to narrow the gap between China and other developing nations; the government focused education on new technology, information science and

advanced management (U.S. Department of the Army, 1994). As a result of the government's emphasis, Internet access is spreading quickly (Qiang, 1995). China has some 900 e-mail users; the small number reflects the comparatively high fees for this service (Qiang, 1995).

Ghana, a largely agricultural country, has a population of almost 18 million with 51% in the 15 to 64 age range (ITA, 1997a). English is the official language, but several African languages are also spoken (ITA, 1997a). Ghana has twice the per capita output of the poorer countries in West Africa, but its economy centers around subsistence agriculture (ITA, 1997a). As in other developing nations, Ghana seeks the benefits of telecommunications technology. During 1996, the Ministry of Education created 36 science centers, equipped with computers, in selected senior secondary schools (Peprah, 1997). Nevertheless, Africa remains the least computerized continent; computers have as yet to penetrate many important sectors of the Ghanaian economy (Darkwa, 1996). Many Ghanaians lack computer skills, from basic knowledge to advanced knowledge and computer management (Darkwa, 1996). This lack of computer competency and lack of Internet access limits success in technology adoption. As in many developing nations, insufficient resources in the form of well-trained computer technology personnel and the capital to train them handicap Ghana (Morwenna & Parker-Jenkins, 1994).

Currently the United States has over 268 million people (U.S. Census Bureau, November 1997) with 65% between 15 and 64 years of age (ITA, 1997b). In 1992 an estimated 83.4% of Americans were White; this group is projected to be the slowest growing among the five racial/ethnic groups in the national census (U.S. Census Bureau, 1997a). Blacks comprise 12.7% of the U.S. population, Hispanics 8.9%, Asian and Pacific Islanders about 3.3%, and American Indian, Eskimo, and Aleuts 0.8% (U.S. Census Bureau, 1997b). Though English is the common language, 13.8% speak another language at home (U.S. Census Bureau, 1990). American schools have more computers and a higher ratio of computers to students than schools in other countries (Anderson, Beebe, Lundmark, Magnan, & Palmer, 1994). However, gender, ethnic and racial inequalities in computer access continue to persist (Coley, Cradler & Engel, 1997).

Hypotheses and Instrumentation

The researchers posed the following null hypotheses:

- Preferred ways of learning about computers do not differ across cultures and countries.
- Attitudes towards computer technology do not differ across cultures and countries.
- Perceptions of usefulness of computer technology do not differ across cultures.
- Increased access to computers is not related to more positive attitudes toward computer technology.

To test their hypotheses, the researchers developed a four-part questionnaire to address computer training preferences, computer attitudes and perceptions, and computer access. The first part, consisting mostly of multiple-choice questions and some open-ended questions, gathers demographic information such as sex and college major. The second part, also containing multiple-choice and some open-ended questions, gathers information about computer access and training. The third part, a twenty-seven item four-point Likert scale, elicits attitudes and perceptions toward computers. Part four, a four-point Likert scale with thirty-six items, explores training preferences and perceptions of computer technology.

A Spanish- and a Mandarin-speaking faculty translated the questionnaire into Chinese and into Spanish. Then they translated these back into English to ensure accuracy of translations. Results of a pilot administered to American college students majoring in business and education at a metropolitan university in the Southwest helped refine the instrument.

Sample

The Chinese sample consists of 53 Business majors and 44 from various other majors who attend Shandong University in Jinan, the capital of Shandong province in the People's Republic of China. Shandong University, with approximately 10,000 students, is a doctoral-granting institution and one of 37 key universities in China. The United States sample consists of 59 Business and 39 Education majors enrolled at Arizona State University West, an upper division, Masters-granting university in a large metropolitan area. The Ghanaian sample consists of 25 Business majors, 26 Business majors, and 48 from other disciplines who attend Cape Coast University. This institution is considered the premier university in Ghana.

The size of the sample is similar for each country, but the mean age of students in each is very different. The U.S. average age is 28.6 years, the Ghanaian average age 21.61 years, and the Chinese average 19.86 years. The age difference is due to the near absence of "adult" education in China where students are traditional age. The American sample comes from an upper division university where most students are "non-traditional" adults.

There are 27 females and 72 males in the Ghanaian sample; 63 males and 34 females in the Chinese sample and 34 males and 63 females in the U.S. sample. The high number of females in the U.S. survey is due to the many female undergraduate Education majors in the U.S. The percent of Business students in both U.S. and China who are females is quite low, plus the typical percent of female students in Chinese universities is below 50%.

Racial and ethnic backgrounds are almost homogeneous in each of the three national samples. Among the Chinese, there were 95 Han and 2 that indicated "other" ethnic

minority. The sample from Ghana consisted exclusively of Ghanaian people. The United States sample consisted of 71 Caucasians (non-Hispanic), 15 Hispanic Americans, 3 Asian Americans, 3 African Americans, and 5 undeclared individuals.

The samples are essentially convenience samples and, therefore, it is difficult to generalize from this data. The numbers are almost equivalent to percents due to sample sizes of almost 100 in each country. The U.S. data was collected in February of 1997; the Chinese data was collected in June of 1997 and the Ghanaian data in April of 1997.

Procedure

The researchers mailed copies of the final questionnaire to collaborating faculty at participating universities in each designated country. The collaborating faculty also received specific instructions for administering the questionnaire, as well as a cover letter to students ensuring their anonymity. The faculty administered the questionnaire to one hundred Education and Business freshmen at their institutions. The researchers personally collected the U.S. data from students attending Education and Business classes.

Results

The number of students who own their own computers is very different. Only five Chinese students and six Ghanaians students in our sample have a computer at home. However, 76 of the 97 U.S. students have computers. Though few Chinese and Ghanaian students can afford to own computers, they feel as positive towards computers as the U.S. students do. The data support the second, third and fourth hypotheses.

Forty-one (42.3%) of the Chinese students and thirty-one (31.3%) of the Ghanaian students preferred to share the computer with another while working on it in the university labs. The limited number of computers among Chinese and Ghanaian students dictate that they share computers when they work on their assignments. The same is not true for the U.S. students in our sample. Only seven U.S. students (7.1%) preferred to share a computer. This finding does not support the first hypothesis.

Only eight Chinese and seven Ghanaian students use computers at work. In contrast, 43 U.S. students use computers at work. This is not surprising since more U.S. than Chinese and Ghanaian students work while attending the university and virtually all U.S. businesses use computers.

Sixty-five U.S. and thirty-nine Ghanaian students used Windows. Seventy-six Chinese students used DOS without Windows. Fifty of the Ghanaian students did not know what operating system they had been using.

U.S. students spend more time using computers (15.28 hours per week) than the Chinese students (4.73 hours per week) or the Ghanaian students (1.77 hours). Concomitant with this difference in usage is a difference in self-reported computer competency. The Chinese and Ghanaians reported feeling less competent in their use of computers than did the U.S. students. Hence more U.S. students than Chinese and Ghanaians feel that computers are significant in their ability to conduct their work.

Conclusions and Implications

The differences in computer ownership among Chinese, Ghanaian and U.S. students reflect economic realities. In our personal experience, the few Chinese and Ghanaian students who own a computer are likely to live at home and be the children of university professors. Because much of the hardware and software is produced and sold by more affluent nations, the expense of importation makes the acquisition and maintenance of computers prohibitive for many people in developing countries.

Similarly, the willingness of Chinese and Ghanaian students to share a computer during work has economic and cultural roots. The limited number of computers among Chinese and Ghanaian students dictates that they share computers. Since the survey asked students if they "preferred" to share computers, the Chinese and Ghanaian students could have answered "no" if they preferred working alone. The fact that they indicated a preference for sharing computers is, therefore, indicative of a cultural valuing of collaboration and sharing. The willingness to share the computer fits within the larger cultural context of collaboration and establishing close relationships.

The use of DOS versus Windows indicates that the power and relative state-of-the-art of the Chinese computers is significantly lower than in the United States. The fact that 57.7% of the Ghanaian sample either did not know or did not indicate a platform is intriguing. This response may indicate a general lack of computer knowledge or a lack of knowledge about the specific computers used. Given Darkwa's (1966) statement regarding the need for increased computer skills among Ghanaians, it is likely that a lack of computer competence underlies this finding.

The authors find the attitudinal differences interesting and informative. The Chinese and Ghanaians feel as positive towards computers as U.S. students do, though they have less access to computers. At the same time, they report feeling less competent in their use of computers than do the U.S. students. Because of the perceived inherent benefits of the computer and the general lack of access to it, the computer has become an object of positive desire. In the U. S., the every-day presence and abundant supply of computers have made computers accessible to students. American's fascination with progress and technology leads to positive attitudes toward computers.

At the same time, social and political forces equate computers with economic progress and national well being. Indeed, the political and social push toward technology may have a positive influence on attitudes towards computers.

Even those with few opportunities to use a computer believe that it is important for economic growth. The government in the People's Republic places heavy pressure on Chinese students to support two major educational goals: to master English and to learn to use computers. Hence their attitudes and feelings towards computers are very positive.

Our findings suggest that access and competency are closely linked; those who have the most access also tend to rate themselves as more computer competent. This finding is consistent with previous research and with the need for extended hands-on practice before individuals feel computer competent.

Our findings suggest that students arriving at our institutions of higher learning from Ghana and mainland China will have positive attitudes towards computers, but are likely to have little experience and competence in using them. Given the increasing incorporation of technology in higher education, these students will be at a distinct disadvantage in classes where instructors require word-processed papers, internet searches for information, or even asynchronous learning activities. By the same token, American businesses in these countries will need to invest in employee computer training.

Our findings also suggest that attitudes and competence may not be directly related. Students with positive attitudes towards computers may still lack necessary computer skills. Societal and political valuing of computers seem to play a strong role in the development of computer attitudes.

In addition, our data suggest that cultural values and socio-economic factors influence how people prefer to work with the computer. Where collaboration is valued, individualized computer use may not be valued. Further research on culture and technology will increase our understanding of diverse learners' needs and expectations.

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Using Live Teleconferences to Promote Diverse Perspectives

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It is frequently a challenge for educators to help students, whether K-12 or university, gain an authentic understanding of communities and cultures other than their own. This may be an even greater challenge in areas of our country that are rural or isolated. By using technology in creative ways, collaborations of teachers and students can help create greater understanding of diverse perspectives. Teachers in Kansas and Alaska recently collaborated to host a live teleconference to help meet that goal.

Description of the Participants

This collaborative project focused on two middle schools—Burlington Middle School, Burlington, Kansas, and Dzantik'I Heeni Middle School, Juneau, Alaska. The Kansas school is situated in a rural area about an hour's drive from Topeka. The Juneau school, while situated in the capitol city, is geographically isolated—no roads connect to other towns—nestled between high mountain peaks that border Canada and the Inland Passage waterways. Juneau's population is 31,000; the school district has 5,666 students and the middle school 750. Juneau teacher Devin Jones explains the status of Juneau-Douglas School District technology:

Four years ago the city of Juneau passed the first of two bond measures with the purpose of purchasing technology ($3 million). We went from a smattering of non-networked Apple IIe's to a fully networked district with a direct 58k connection to the Internet. The second bond ($4 million) was and still is being used to purchase hardware at a ratio of 4 computers per student. Building technology committees identified additional hardware...scanners, projection devices, alpha smarts, digital cameras. Unfortunately, very little of the bond money was set aside to train staff...this is the area the district is trying to address now (D. Jones. email communication, November 18, 1997).

The partner school in Alaska had infused local Native American cultural heritage as well as sophisticated technology in the curriculum and instruction. For example, the Alaska students had researched and developed web sites reflecting local geography and Native American culture. The unique Alaskan perspectives and experiences could be shared with the Kansas students, who, although from a culturally non-diverse rural community, had a rich historical background to share. The web projects of the Juneau middle school may be accessed at http://jsd.k12.ak.us/WWW/AKonline/AKhome.html and at http://jsd.k12.ak.us/WWW/Schools/dzh/dzh.html.

The partner school in Kansas, Burlington Middle School (USD #244), is located in a small rural community of 3500 population, with a school district enrollment of 1000 and 250 at the middle school. Project participants were teachers Janice McCullough and Jackie Rolf. The Burlington District Curriculum Coordinator, Toni Bowling, explained:

Burlington is in the sixth year of aggressive technology implementation. The district has a strong technology integration program throughout its K-12 curriculum. With over 450 networked computers throughout the building, district and to the Internet, teachers and students have access to effective instructional and learning software and hardware. The district has focused its technology efforts on technology literacy, technology integration, administrative technology, and technology education. Much of the success of our technology implementation is due to yearly district-wide staff development priorities. Staff development funding over the past two years has come from a combination of General Fund and the Educational Excellence Grant Program (T. Bowling, email communication, November 19, 1997).

The university partners in this project, Dr. Kirsten Skarstad and the author, are both from Emporia State University. This institution has approximately 6,000 student, and is located in Emporia, a community of 27,000 midway between Kansas City and Wichita. The Teachers College at ESU (http://www.emporia.edu/N/www/sleme/intro.htm) was founded in 1863 and remains the state's premier teacher-training institution.

Description of the Project

This live teleconference, designed to promote diverse perspectives, began as part of a Goals 2000 grant focused on

alternative assessments. The Burlington Middle School social studies curriculum outcomes required students to research a specific culture and prepare a project for a sixth-grade culture fair to which parents and community members would be invited. The teachers in this project felt that opportunities for the middle school students to connect with individuals from diverse cultures and geographic areas would enhance the social studies curriculum. Thus, the idea for a university campus visit developed into a "Windows to the World" conference that included presentations from college students and community members that focused on a variety of cultures. The live video teleconference with Dzantik'I Heeni Middle School, Juneau, Alaska highlighted the day's events.

The teleconference was held in one of the media classrooms in The Teachers College. The Burlington Middle School students also used the College computer laboratory with its Internet connections for related cultural research on the day of the teleconference. The Alaskan students used the teleconference facilities at the University of Alaska campus in Juneau.

The teleconference included a student-prepared and student-led presentation about Kansas culture and history that was then matched by a similar presentation from the Alaskan students. Students from Burlington and Juneau exchanged questions ahead of time via fax and email regarding their areas of interest and then discussed these questions during the teleconference. Burlington students also had an opportunity to view the web site on Alaska history and geography that the Alaska school had researched and designed and to visit other web sites for resources to use in their Culture Fair projects. The Burlington students also used a diversity web site that the author and students in the Cultural Awareness for Educators course at Emporia State University had developed (http://www.emporia.edu/N/www/sleme/mcsite.htm).

After the university campus visit and the teleconference with Alaska, the Burlington Middle School students returned to their rural community and completed their cultural projects and presented them to parents and community members at a special evening event, a "Culture Fair," that was also featured in local newspapers. Many parents helped their children plan their displays, provided cultural family artifacts and ethnic cooking, and even joined their children at the displays.

The Burlington students' participation and products were assessed using teacher-designed performance rubrics which addressed student use of the technology (the live teleconference and Internet) and the product produced for the Culture Fair. Classroom teaching in both states reflected state and national standards that emphasized what students think and can do as a result of their experiences. These experiences provided opportunities for students to practice written and oral communications skills in a real-life setting. Both school districts' goals also emphasized high-performance outcomes that relate to civic education in a democratic society; this project helped students work towards this outcome.

Teacher education students at Emporia State University benefited from this project because Burlington Middle School teacher partners visited the campus and spoke to students about their efforts to use alternative assessments. The students were also invited to help with the Windows to the World conference and to observe the teleconference.

Project Strengths

A live teleconference adds new dimensions to teaching and learning and, specifically, to promoting knowledge and understanding of diverse perspectives. This technology allows students and educators to have greater connections with other cultures and resources in ways that previous methods could not accomplish. While email projects have become increasingly common, the added dimensions of a large color screen with sound made live interactivity particularly exciting for everyone. Yet, we are just beginning the road to creating a deeper understanding of each other and the power of technology. In this project, the Kansas middle school students learned via technology how the Alaska students were able to conduct community research and construct a web page to share that knowledge with the world. This is an excellent "students teaching students" type of learning that provides opportunities for students to practice written and oral communications skills in a real-life setting.

Partnerships such as this technology-enhanced cultural project provide a model that could be used for a variety of themes and audiences and become as extensive as time and money might allow. The Alaskan and Kansas school districts and universities were generous with their support of this entire effort. The technology staffs at both universities worked diligently to coordinate the live teleconference and stand ready to troubleshoot if technical difficulties occurred.

Project Challenges

Project participants felt that all of the student and teacher activities were successful. Future projects of a similar nature should, however, take into consideration the tremendous amount of time and coordination that was involved with the array of activities that became part of this project. The video teleconference posed the challenge of finding funding and a suitable partner and hoping that the technology at both sites would work perfectly, which it did. The students noted the video teleconference as the project highlight, although the Burlington students were also excited to use the Internet and listen to speakers from diverse cultural backgrounds. Another challenge faced was to work within the schedule of a very busy campus computer lab to allow the Burlington students the use of the computer lab. It would have been better to have more time

for the students to explore the Internet, as it often takes a while to dig for the best resources. Similarly, it would have been even more rewarding to have developed a closer relationship between the two middle schools before the live teleconference. Unfortunately, the Burlington Middle School did not have Internet connections, which would have made this much easier. One minor challenge involved 'red tape' items, such as getting the Permission to Video Tape Release Forms back from the Burlington students and their parents. Some students in the end were not able to attend because they did not have these permission slips returned.

Implications for the Future

If we are educating for a democratic society, collaborative efforts that promote understanding and acceptance of diversity become increasingly more important in our communities and indeed globally. This project provided a viable model for schools with limited resources situated in geographic areas limited in diversity who would like to deliver multicultural education more effectively and authentically. The need to make these connections and continue them at deeper, long-term levels provides important future opportunities for diversity education. This author recommends that projects of a similar nature also allow for student assessment in diverse ways, such as the use of rubrics and written student reactions/journal entries.

The Windows to the World collaboration helped middle school students, faculty, and prospective teachers enhance their beliefs and understandings about learning by creating an environment that reaches outside the windows of the classroom to promote global understanding. Planners of this teleconference hope that the middle school students will begin to view the world differently because of their greater understanding of diverse cultures and geographies gained from their own active learning.

The author encourages readers to contact her if they would like to become a partner in a similar project.

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A Multimedia Comparison of Value Orientations Between Chinese and American Elementary Textbooks

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Values education is one of the most controversial issues in the United States. Hardly any teacher or administrator in American public schools likes the term *values education*, or its alternative terms: *moral education*, *character development*, and *ethics education* (SSHE, 1991). Compared with this American phenomenon, values education in the Chinese elementary curriculum is less controversial due to the *Outline for Values Education in Elementary Schools* stipulated by the Chinese State Educational Commission in 1988. No matter how controversial the issue of values education appears, all elementary curricula in Chinese and American schools include a large amount of time teaching values, though the definitions and content of values taught may differ significantly.

According to the Hastings Center's report (1991) on the teaching of ethics, *values* are generally used to denote the "normative, valuational, and subjective side of human life," and *ethics* more often refer to ethical theories and the "application of principles and norms to moral problems". The American Heritage Dictionary (1991) defines value as "a principle, standard, or quality considered worthwhile or desirable". *Values education*, as used in this article, includes both normative values and their application principles for students.

Although values education in the elementary curriculum helps students develop normative values and application principles in ethical issues, the means by which it is accomplished in Chinese and American elementary curricula are substantially different. These differences are reflected in teaching objectives, instructional content and teaching methods.

The first part of this paper examines what values are advocated in the elementary textbooks of Chinese and American schools and analyzes these differences in the context of their social and cultural backgrounds. The second part describes how the researcher uses the Asymmetric ToolBook and the Microsoft Power Point to present the research in a multimedia environment.

How Values Education Is Taught in Chinese and American Elementary Schools

In 1988 the Chinese State Education Commission promulgated the *Outline for Values Education in Elementary Schools*. It set the aims, content, basic requirements, principles and implementation methods for values education in the elementary schools. The goal of the Outline was to teach students good behavior through cultivating the Five Loves (i.e., love for the country, love for the people, love of work, love for science and love for socialism/leaders). These goals were to be achieved through moral education classes, values education in other subjects, extracurricular activities, after school activities organized by the Young Pioneers and student associations, and through support of families and the society as a whole (CSEC, 1994).

Because Chinese elementary students only have an hour of moral education every week—an elementary total of 170 to 240 hours depending on 5-year or 6-year schooling,many values education goals have to be achieved through subject classes. Thus the Chinese language arts class has an average of 10 hours every week and a total of 1666 to 1734 hours depending on years elementary schooling (CSEC. 1994). In addition to the content of the Language Arts, the Chinese language arts class also includes much of the values education content of Social Studies found in American elementary schools.

On the other hand, setting aside a class called *Moral Education* in American public schools is virtually impossible. Few educators and parents will endorse it. As Wagner (1996) put it, "Efforts to impose forms of character education with a predetermined set of values onto students and communities often provoke bitter and divisive debate between many liberals and conservatives" (p.36). Therefore, there is no separate subject labeled *Values Education* in American schools. Most of the teaching objectives related to values education are to be fulfilled in the social studies class. Consequently, the writer selected the Chinese language arts textbooks and the American social studies textbooks to compare the values orientation of their elementary curricula.

The Chinese language arts textbooks selected for the research were the 3rd to 8th volumes of the *Elementary Chinese Textbooks for the Six-Year Elementary System*. The 1st and 2nd volumes were basically Chinese character recognition; beyond the 9th volume, there was mostly literature. Therefore, the writer used the 2nd through 4th grade textbooks (i.e., 3rd to 8th volumes) to examine the major content and values orientation. The American textbooks selected were the *Houghton Mifflin Social Studies Series* (1994). It was one of the popular social studies textbook series for American elementary schools.

Values Emphasized in American Elementary Textbooks

John Jarolimek (1990), Chair of the Task Force on Scope and Sequence of the National Council of Social Studies, summed up the democratic beliefs and values that should be taught in the social studies class of public schools as: rights of the individual, freedoms of the individual, responsibilities of the individual, and beliefs concerning societal conditions and governmental responsibilities. The Houghton Mifflin series emphasized: (a) National Identity, which includes pluralism, democracy, American symbols, and reaffirmation of American ideals; (b) Constitutional Heritage, which consists of balance of power, origin of constitution, and reinterpretation of ideals; and (c) Citizenship, which covers individual and state, democratic behaviors, selection of leaders, human rights, settlement of disputes, and strategies for pluralism.

Based on Jarolimek's recommendations (Jarolimek, 1990), the Scope and Sequence of the Houghton Mifflin series (Houghton Mifflin, 1994), and David Saxe's analysis in *Social Studies for the Elementary Teacher* (Saxe, 1994), the values highlighted in the American elementary social studies textbooks may be summed up as individual rights, personal freedom and responsibilities, constitutional heritage, and national/personal identities. Table 1 illustrates the values in the American social studies textbooks:

Values Highlighted in the Chinese Elementary Textbooks

Because there was no detailed outline of values education in the Chinese textbooks selected, the writer used a self-designed instrument. To examine the major value messages advocated in the Chinese Language Arts textbooks, the writer combined the major values Chinese education goals of Five-Loves with one of the most important values in American textbooks, i.e., individual rights. These categories are: (a) Love for Science (including natural facts and stories of scientists), (b) Love for Political Leaders and Social System, (c) Appreciation of Cultural Heritage, (d) Affirmation of Individual Rights, and (e) Other Values.

Procedure

Based on these five categories, the writer counted and clustered the major themes/moral messages delivered in each textbook to examine their values orientation. For example, a story about the late Premier Zhou Enlai and his caring for people was grouped under Love for Political Leaders, and "The Story of Isaac Newton" was clustered under Love for Science. By using the lesson as a unit, the writer counted a total of 190 lessons in the 8 volumes of the textbooks. If the researcher discerned multiple value messages, the lesson went to the category which highlighted its most prominent moral message. To test the validity of the instrument, a pilot study was conducted. The researcher shared her counting and content analysis of 5 lessons with the students and teachers of the Hope Chinese School in Maryland and revised her instrument accordingly. The results of the research are presented in Table 2.

Table 1.
Advocated Values in Social Studies Textbooks for American Students

Rights of Individual Identity	Personal Freedom	Responsibilities	Constitutional	National/Personal Heritage
-Right to life	-Freedom to participate in political process	-Respect human life	-Citizenship	-National iden.
-Right to liberty		-Respect rights of others	-Belief in a democratic government	-Individual Iden.
-Right to dignity		-Respect property of others	-Development of Constitution	-Macro cultures
-Right to security	-Freedom of worship	-Be honest thought	-Be compassionate	-Micro culture
-Right to equality	-Freedom of opportunity	-Demonstrate self-control		-Components of the Constitution
-Right to	-Freedom of conscience	-Participate in the democratic process	Constitution	-Application of the
	-Freedom of assembly			
	-Freedom of inquiry			

Based on the Social Studies Guidelines of John Jarolimek, Scope and Sequence of Houghton Mifflin Social Studies Series and David Saxe's Social Studies for the Elementary Teacher.
(Changes made by Julie Bao, 1997)

Table 2.
Emphasized Values in the Chinese Elementary Language Arts Textbooks

Volumes	Love for Science Natural Facts	Love for Political Leaders/System Stories of Scientists	Appreciation of Cultural Heritage	Affirmation of Individual Rights	Other Values	Total Lessons	
3rd	15	1	3	13	0	1	33
4th	12	3	6	8	0	2	31
5th	17	2	5	6	0	2	32
6th	13	1	7	10	0	1	32
7th	11	2	7	9	0	2	31
8th	12	5	6	5	0	3	31
Total Lessons	80	14	34	51	0	11	190
% of Total	42.1	7.4	17.9	26.8	0.0	5.8	100

If one examines Table 2 in light of the Five-Loves advocated by the Chinese State Education Commission, four of the Loves are sufficiently covered. Indeed, the *Love for Science* category takes up about half of the content. The 5th category, *Love for Work*, though not indicated in a separate category, is well represented in many lessons. It is *Affirming Individual Rights*, one of the most important values in American culture, that is hardly mentioned in any of the Chinese elementary Language Arts textbooks. Figure 1 illustrates the cluster and percentages of core values in 190 Chinese lessons.

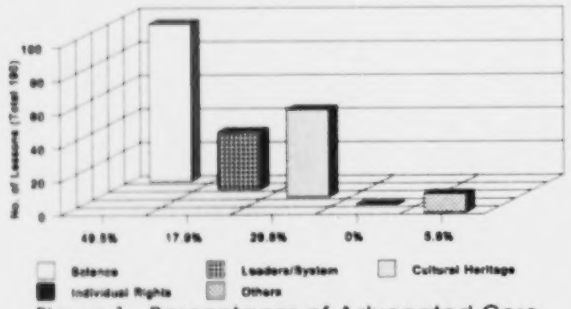

Figure 1. Percentages of Advocated Core Values in 190 Chinese Lessons.

Differences in Values Education between American and Chinese Schools

The data above show a substantial difference in the orientation of values education between Chinese and American schools. These differences can be perceived as differences in attitudes, differences in content, differences in teaching methods, and differences in outcomes.

Attitude Differences

The first difference between American and Chinese elementary schools lies in the different attitudes toward values education. In China, values education is generally regarded as a positive term. Moral education is advocated and built into the formal curricula of elementary schools. In contrast to this Chinese attitude, most American teachers and parents view values education as problematic. Many parents and church groups challenge the values taught in public schools and demand parental control in shaping their children's value system.

Content Differences

As shown in the two tables above, the values taught and emphasized in these two countries are very different. The American values system emphasizes rights, freedom, identity and constitutional heritage. Love for others is not a priority value in mainstream American culture. On the other hand, the Chinese system emphasizes the Five Loves and personal responsibilities. The concept of individual rights and freedom, a primary value in American society, is hardly encouraged in Chinese elementary textbooks. Just as American schools emphasize individual rights, Chinese schools place great emphasis on individual responsibilities. From children's classroom responsibilities to the roles of a citizen, the concept of personal responsibilities is well specified in the Chinese textbooks.

Method Differences

Compared with the traditional teaching methods in Chinese classrooms which involve much written work and rote learning, the American elementary classroom provides far more participatory and hands-on approaches. From acting out the role of a citizen to designing a classroom constitution, American students are asked, from a very early age, to participate in the democratic process. During instruction, numerous teaching aids are employed to teach

values, such as making a Flag Cake to teach American symbols and ideals. Fun and hands-on exploration are highly emphasized throughout the learning process.

Outcome Differences.

To observe the impact of values education on American young adults and determine their perceptions of values, the writer conducted a study among 70 Education seniors at Shippensburg University. The writer designed a questionnaire by mixing the Five Loves recommended by the Chinese State Educational Commission with the five values highlighted by Jarolimek and the Houghton Mifflin Social Studies Series. The writer asked the students to rearrange them in the order of their importance to them.

Of the 70 students that completed the questionnaire, 34 people (49%) ranked Freedom of the Individual as the most important value for them and 26 (37%) ranked the Rights of the Individual highest. The combined rate of ranking the Freedom of the Individual and Rights of the Individual as most important totaled 60 people, 86% of the participants.

Ranked as least important values were *Love for Science* and *Love for My System*. Though the writer changed the political phrase of *Love for Socialism* into *Love for my Social System*, fifty-two students (74%) ranked it as the least important. Figure 2 illustrates the percentages of the most important values.

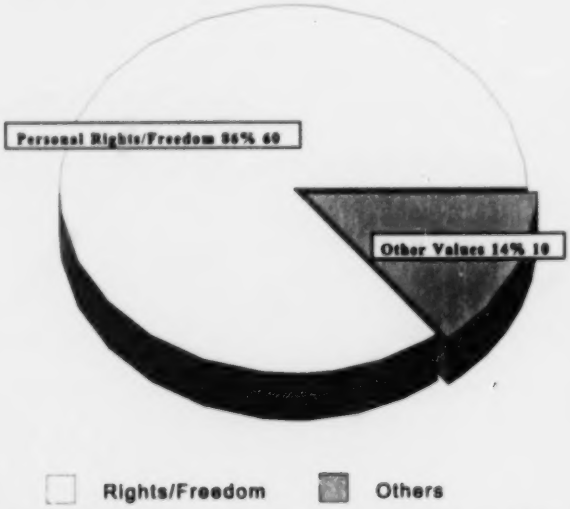

Figure 2. Most Important Values for 70 American College Students

Summary and Discussions

A comparison of Chinese and American elementary textbooks indicates a substantial difference in values education in the two countries. The American textbooks tend to emphasize personal rights, freedom, identity and the constitutional heritage, while the Chinese educational system uses the Five-Love principles to teach their children.

The different values orientation in school textbooks reflect the different social and cultural traditions of the two countries. The American schools are created in the spirit of the Declaration of Independence and guided by the Constitution of the United States. Both documents are largely born out of a philosophy that has its roots in the Magna Carter and in Social Contract theory. The macroculture of American society subscribes to a values system that has freedom, rights and individualism at its heart. The American macroculture maximizes individual gains within a legal framework. Working for the interest of others is a secondary orientation in American society. This is why when the late President John F. Kennedy (1961) said, "Ask not what your country can do for you, ask what you can do for your country," it became a pacesetting message for the nation.

On the other hand, the same famous quote could have been said ideologically by thousands of Chinese political instructors because it is a dominant value in Chinese society. The guidelines of values education for Chinese schools are largely based on Confucius' philosophy which emphasizes individual responsibility and service to the family, community and the country. The values education curricula of both countries are invariably rooted in their historical and cultural backgrounds.

Grounded in different cultural heritage and nurtured by prevailing social philosophies, the values education curriculum is, first of all, a product of a society. It then adds to that society by helping prepare ideal citizens who perpetuate and improve the existing system. The experience of comparing values education in Chinese and American elementary textbooks illustrated this very phenomenon.

Multimedia Presentation of Research

The multimedia presentation of this research was originally created by Asymmetric ToolBook II 5.0, a software construction set that teachers can use to develop their teaching projects. It has all the features of Windows applications, such as graphical user interface, event-driven programming and ability to interact with other Windows applications. The researcher used its graphics, buttons, sound, animation and Openscript features to create a multimedia presentation of the above research. For the sake of software compatibility and presentation convenience at the 9th SITE Conference, the researcher converted it into a Power Point presentation. The finished product contains 40 screens consisting of twenty digital pictures, 3 movie clips, 3 figures, some music and many hypertext pages. Though some of the animations are lost in the transition, their design principles and major features are quite similar. Some of the designer's experiences follow.

OverAll Design of the Presentation

The overall design of a multimedia presentation is critical. The designer not only has to consider what she

wants to present, but also what messages the audience will get from viewing the hypertext screens. Very often the audience is drawn toward the dazzling electronic bells and whistles. The designer needs to spend much time at the beginning of the project selecting the most effective communication approaches.

Readability of the Screen

Readability of the screen is very important because the bulk of the information will be obtained from the screen. Select an appropriate font size, use content words and limit the number of headings. The font for the opening page may be set at about 40 points with each page containing no more than 6 lines. It is unnecessary to write detailed information on the screen; when the presenter reads the 5 to 6 essential words in a line, the readers will be able to fill in the rest of the information. For general purposes, using templates is often a convenient shortcut.

Import Digital Images

The Asymmetric ToolBook and Power Point employ different ways to import graphs, charts, pictures, and videos, but the methods are more or less the same, namely, cut and paste, insert or import. Spending some time on the software, one will get used to them quickly. It is the creativity and depth of the project and selection of images that will take the bulk of one's time.

Avoid Screen Clutter

Because multimedia software enables the author to use fancy tools with great ease, it is important not to distract the readers by using too many dazzling digital images or music. Sometimes, excessive use of transitions and special effects may make your presentation *too* cute. Consequently, the ultimate purpose of the presentation is compromised.

Logical Reasoning vs. Non-linear Nature of Multimedia Presentation

Multimedia is any combination of data, digital movies, animations, graphics, text, and sound delivered on a computer. It is a highly non-linear environment. Therefore, the designer needs to balance the logical and sequential presentation of main content pages with the temptation of using overwhelming effects.

Navigation Control

It is important that the presenter design the demonstration in a way that allows her to navigate the demonstration with ease and to change the length and direction of each screen at will.

Selecting and designing a multimedia presentation is a never-ending learning process. In this project, the researcher tried Macromedia Director, Autherware, Asymmetric ToolBook II, and, finally, Microsoft Power Point. She might have just scratched the surface of the capacities of these multimedia software programs, but one thing is clear—a multimedia environment has certainly made her presentation more effective and, therefore, made her research more accessible to more students and colleagues.

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Technology and the Moral Sense: Re-Wiring Moral Education

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It's a random kind of thing
Come upon a delicate flower
I can't believe a machine gun sings
Driveby, driveby, driveby, driveby
— Neil Young

Although written in 1994, the lyrics of Neil Young's "Driveby" clearly foreshadow what has become an even more common occurrence in 1997. From his concerns about driveby shootings, we have moved to frequent reports of in-school muggings and abandonment of newborns in dumpsters and toilets. Consequently, these events have prompted many parents and educators to demand increased attention to our children's moral education. Under such pressure, many educators have turned again to programs using values clarification and/or moral reasoning. Critics, however, claim that such programs lack the moral content to provide learners with a true moral compass to guide their actions (Sommers, 1984). Others respond that the diversity of values among the burgeoning public school communities render a consensus on moral education almost impossible. We intend to give a brief synopsis of recent trends in moral education and suggest ways in which a blending of idea and product technologies can promote the development of four specific moral sentiments.

Background: Grounding Our Moral Circuitry

Moral education has, in various forms, been a consistent component of American education since colonial times; however, dramatic changes in recent American culture have rendered efforts at engaging moral education in the public school classroom increasingly controversial. Commenting on this reality, McClellan (1992) explained that during the 1960's and 1970's:

> The forces that made moral education so problematic for public schools were the products of a number of social and cultural upheavals. The effort to end racial discrimination, the waging of an unpopular war, a deepening cultural pluralism, and a growing willingness to expand the range of acceptable personal conduct all worked to weaken the commitment of schools to moral education. . . . With deep suspicions now sharpening racial, ethnic, and class divisions, Americans lost faith in their ability to find common ground. Increasingly they sought to preserve a fragile peace by accepting differences and encouraging tolerance. In the process, they elevated relativism into a primary social value. (p.84)

In many communities, such relativism became increasingly antagonistic to the "content" of character education programs that prescribed specific virtues and conduct. Consequently, school districts frequently turned to Simon's Values Clarification Program and/or to Kohlberg's Moral Reasoning Approach since each model encouraged, in different ways, the development of a student's personal value and belief system and minimized the cultivation of specific character traits (McClellan, 1992). In various configurations, these two approaches continue to be the scaffolding of numerous moral education programs throughout the country today, although many public schools are returning to "repackaged" character education programs, which ironically often employ elements of values clarification or moral reasoning (Lickona, 1988).

The Moral Sense

Simon's and Kohlberg's respective models, and even contemporary hybrid models of earlier character education programs, focus centrally on the cognitive dimensions of moral conduct—what are the moral issues or dilemmas and how should one address and act on them? Recent research on moral development, however, has identified core moral sentiments or "feeling states" that contribute significantly to

the development of moral awareness and moral behavior. Damon (1988) contends that most scholars believe that emotions are a natural component of a child's social repertoire, and that the potential for moral-emotional reactions is present at birth. Some have gone even further in claiming that moral emotions constitute the one feature that unites humans from all the world's diverse cultures.

While various developmental psychologists and moral educators have been researching these moral sentiments (Damon, 1988, 1994; Kagan, 1984), Wilson's (1993) analysis is especially clear and convincing. He has identified four moral sentiments that, he claims, are innate and that comprise the bedrock of human moral behavior: sympathy, duty, fairness, and self-control. These sentiments are not themselves the "content" of moral action, but rather the predisposition for moral action. Each culture defines how these sentiments are operationalized or put into action (Damon, 1988).

Moral Sentiments: Plugging-In

In the context of Wilson's research, it is clear to us that teacher educators have an obligation to address issues of moral education intentionally by providing preservice and in-service teachers fruitful strategies that foster the cultivation of moral sentiments. Furthermore, we contend that educational technology is an especially effective tool in engendering the development of sympathy, duty, fairness, and self-control in the classroom. With these assertions in mind, we intend that this paper serve as a point of departure for teacher educators—especially for those who teach technology utilization courses. We showcase here four foundational moral sentiments that may be incorporated with educational technology, basically a blending of product and idea technologies (Sweeder, Bednar, & Ryan, in press; Hooper & Reiber, 1995). Four integrated strategies that we believe pre- and in-service teachers can use to "plug into" those moral sentiments include virtual gatherings, social action projects, problem-solving computer courseware, and video production projects. It is our hope that by introducing our pre and in-service teachers to these strategies that they will, in turn, share them with *their* present and/or future students in order to heighten *their* moral sensibilities.

Virtual Gatherings: Sympathy

A virtual gathering (Harris, 1995) is a form of telecommunication activity which is meant to "bring together participants from different geographic locations and time zones in real-time to either participate virtually 'in person,' in a computer-mediated meeting, or simultaneously 'in spirit,' without direct electronic contact, in similar activities at different project sites" (p.61). Virtual gatherings appear to be an ideal way for teachers to develop the moral sentiment of sympathy. For instance, after defining what virtual gatherings are and discussing examples of how they have been used in basic education, teacher educators can have their pre and in-service teachers invent their own virtual gathering projects. For example, one might have pre and in-service teachers participate in a combination of outreach activities similar to one identified by Harris as "A Day Without Art, " which took place in Florida across all sixty-seven school districts in observance of the Eighth Annual World AIDS Day (1995). Using a combination of Internet Relay Chats, and a preorganized symbolic action targeting the removal of blindfolds from museum statuary, "A Day Without Art" helped not only to develop AIDS awareness, but also to engender sympathy for the welfare of those afflicted with that life-threatening disease.

Harris' virtual gathering project might serve as a template for other ways in which we could develop student awareness for the moral sentiment of sympathy: Why not "A Day Without TV," in order to spend some time visiting or talking to the elderly or infirm, or "A Day Without Dessert" in order to devote time collecting food for the homeless both at home and abroad? Using curriculum-specific topics as springboards, science, literature, or mathematics teachers could concurrently address content and/or community-based concerns, technology use, and emotional pre-dispositions.

The Social Action Project: Duty

Teacher educators can also use the Internet to help their pre- and in-service teachers tap into a variety of real world contexts for humanitarian, action-oriented telecommunications activities which involve children. "Social action projects" range from helping raise money in aiding the homeless, to organizing, scheduling, and conducting worldwide beach sweeps in order to "Save the Earth's Beaches." Again, technology-infused projects of this nature address not only traditional curricular concerns but also heighten students' moral consciousness and develop their communal, if not universal, sense of duty or responsibility to humanity.

Decisions, Decisions: Fairness

An effective way teacher educators might help pre- and in-service teachers recognize how to incorporate the moral sentiment of fairness would be through the careful selection and re-purposing of computer courseware. For example, Tom Snyder's *Decisions, Decisions: The Environment* (Dockterman, 1990) and its accompanying teacher's guide (Dockterman, 1988) are primarily intended to improve student decision-making and critical thinking skills. However, with a modicum of creativity, classroom teachers can readily adapt this technology to develop their students' moral sense of *fairness*. In *Decisions, Decisions: The Environment*, students are encouraged via small and/or large group collaboration, multiple perspective-taking, and role-playing simulations to analyze and solve a "real-life situation" —namely, What is causing fish to die in the local pond? Playing the role of the mayor of Alpine, students are asked not only to solve this multifaceted problem, but also

take into consideration the advice of four mayoral advisors: an independent scientist, an economist, a campaign manager, and a representative of an environmental council.

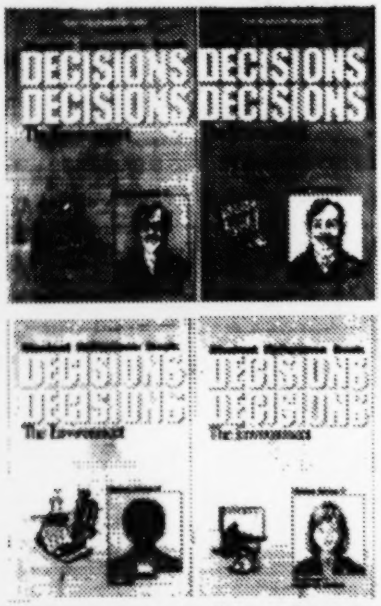

Figure 1: Four mayoral advisors from Decisions, Decisions: The Environment

In addition, the mayor has to weigh and balance a number of other complicating circumstances, such as preserving the valuable jobs which are at stake at the local mining company, a company which may be the possible source of the pond's pollution problem. All of this, by the way, takes place during a crucial election year!

Video Production: Self-Control

Teacher educators can explore the moral sentiment of *self-control* with their pre- and in-service students through video production projects. For instance, by experiencing the three-stage, videographic process—pre-production, the 'shoot' itself, and post-production—students also learn about the four basic elements of cooperative learning (Kindsvatter, Wilen, & Ishler, 1992), which collectively deal with the establishment, maintenance, and promotion of interpersonal relationships. An important aspect of any challenging, collaborative endeavor such as the creation of a coherent "movie story" (Sherman, 1991) necessitates self-control and the ability to compromise, especially at a video project's outset, the pre-production phase, when themes, plots, characters, dialog, responsibilities, and so on are being invented and determined collectively. Compromise, by definition, involves the settlement of individual differences, at least in the short run, in order to permit a project to move forward, prosper, and meet the longer-range goals of the group: a completed, creative, and coherent video.

Time to Re-Wire

Moral theorists will undoubtedly continue to debate the content and process of moral education, but a cursory review of local newspapers, talkshows, and popular musical lyrics suggests that there is an immediate need for intervention. We believe now is the time to re-wire moral education—not through separate courses or specialized programs, but rather through a creative, integrated circuitry of educational technology soldered to four universal moral sentiments. Since classroom teachers are always on the front lines, teacher educators must provide their pre- and in-service teachers with a range of proactive strategies to use when working with learners.

Acknowledgement

Figure 1. Decisions, Decisions: The Environment courtesy of Tom Snyder Productions

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Teachers Teaching Teachers: The Belen Goals 2000 Professional Development Project

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In a 1995 comprehensive nationwide assessment, the U. S. Congress Office of Technology Assessment (OTA) indicated that, in the process of acquiring hardware and software for students to use, teachers who are perhaps the most valuable part of the education equation are often overlooked. The CEO Forum (1997), for example, reported that of the total dollars spent for technology in schools only 6 percent of those dollars were spent on teacher education. In New Mexico, only 4 percent of technology monies have been slated for professional development (Bingaman, 1997) despite the OTA's recommendation of 30 percent. Seeking assistance to address teacher education needs, Belen Public Schools in Belen, New Mexico submitted a Goals 2000 grant proposal to secure funding for teacher education and technology integration. The grant was awarded for the 1996-97 school year. This paper presents a description of the Belen Goals 2000 Professional Development Project and evaluation data relevant to that project.

A Framework for Professional Development

Designing professional development for an information age means moving away from the traditional model of one size fits all, inadequate opportunity to practice new skills, and little ongoing support (Fulton, 1996; Grant, 1996). Research on professional development suggests that teachers learn best and are more likely to incorporate new approaches into their teaching when they can experiment and reflect in a safe setting. Teachers must have ample opportunity to discuss and collaborate with their peers and instructors (Fulton, 1996; Grant, 1996; Yocam, 1996). Professional development must help teachers "move beyond 'mechanical use' of curriculum and technology to become facilitators of inquiry" (Grant, 1996, p. 1).

> Research says that professional development has to be directly connected to daily work with students, related to content areas, organized around real problems of practice instead of abstractions, continuous and ongoing, and able to provide teachers with access to outside resources and expertise .... Teachers have to practice change and continually work with others on debugging the problems they encounter (Darling-Hammond, 1997, p. 5).

In an effort to support teachers new to technology integration, a number of schools have paired novice and experienced teachers in an approach referred to as mentoring. Key features of the mentoring approach are that assistance is provided within the context of a personal relationship and focused on the needs of the novice user (MacArthur, et. al., 1993). Since teacher/presenters understand classroom culture and the demands of teaching, their guidance is often more relevant and credible to other teachers. Familiar with the regular work in classrooms, these teacher/presenters can help teacher/participants see how technologies can enrich and support learning (Grant, 1996). Teacher/presenters can also play an invaluable role in generating ideas and problem solving with their peers.

Implementing the Project

The Belen Goals 2000 professional development project established workshops designed to facilitate teachers supporting teachers to integrate technology. The workshops were designed to provide opportunities for 48 Belen teachers (a) to experience excellent models of technology integration and (b) to think systematically about the translation of those models into their own classrooms.

Upon notification of the award of the Goals 2000 grant, the original grant writing committee selected Dr. Priscilla Norton as outside facilitator. In addition to the outside facilitator, the grant made provisions for a district-wide inservice program for 48 of the districts 250 teachers, providing money for substitute teachers and stipends. Once a district teacher-training lab with 12 Internet-linked computers existed, the committee met with Dr. Norton to discuss the process of implementing the professional development component of the project.

The committee agreed that a teachers-teaching-teachers model would be implemented. Dr. Norton would design two

three-day workshops; the first workshop would focus on using an integrated software package and the second workshop would focus on using email and the Internet. The committee also agreed to invite all district teachers to participate in the Goals 2000 project, and that 12 facilitators and 36 participants would be selected from those who applied. The teachers selected to participate would be divided into four groups of twelve. One group of twelve would comprise those whose application reflected their desire to participate and their willingness to teach others what they had learned; three groups of twelve each would be designated as participants. The committee decided that the first series of workshops would be presented during February using substitute teachers, and the second series of workshops during the last two weeks of July and the first week of August with stipends given to all attendees. Dr. Norton would conduct each workshop with the facilitators and then selected facilitators would replicate the workshop with the remaining three groups of twelve participants.

The twelve facilitators ranged in age from 26 to 55 years and the majority (90%) was female. Fifty percent were elementary level teachers and the remaining secondary group taught history, Title 1, math, and English. They had an average of 14.8 years of experience. The thirty-six participants ranged in age from 26 to 55 years of age, and the majority (85%) was female. Fifty-eight percent were elementary level teachers and remaining secondary group (42%) taught social studies, Title 1, science, math, special education, and Language Arts. They had an average of 11.4 years of exprience.

Workshops de-emphasized the mechanics of technology and focused on integrating technology with the curriculum. They were structured to engage attendees in model lessons, with attendees becoming content-area learners while also learning about integrating technology. Ample opportunities were built into the structure of each workshop for drawing lessons from their own experiences that might be generalized to their own practice. Each workshop ended with attendees designing a lesson they could use in their own practice.

The February workshop asked attendees to become political activists and prepare a proposal and presentation that would help the workshop leader identify the perfect presidential candidate for educators. Attendees were given a model to use in the preparation of their proposal. Their final proposal had to include a logo and name for their consulting firm. It needed to include the construction, administration, and analysis of a survey. Attendees were assisted in using a word processor to prepare their survey, a spreadsheet for analyzing the results, and a word processor and graphs constructed with the spreadsheet to present a political platform for their candidate. Attendees used a presidential database to identify six historic attributes of an electable president (i.e. the average president is between 50 and 60 years of age). They were asked to create a potential classified advertisement to locate the perfect candidate using these attributes. They were asked to create a slogan for their perfect candidate and prepare either a bumper sticker or poster using the graphics program. Final proposals were spiral bound and presented to the class. The afternoon of the third day was reserved for participants to divide into grade level groups and create a lesson plan modeled on their workshop experience.

The summer workshop introduced attendees to the district's email system and the Internet. Using email accounts established prior to the workshops, the workshop leader made a short presentation on using Pine and then introduced an email version of the game of *Clue*. Next, in small groups, attendees used a list of six URL's to construct a rubric for judging the validity and reliability of an Internet site. Rubrics were shared with the large group. Third, attendees were asked to write down three things about which they would like to learn more. Internet search engines were introduced, and attendees located sites related to their list. On the second day, attendees completed a short WebQuest (Dodge, 1995) using the Internet to research a trip to a Spanish speaking country of their choice and write a letter to their rich uncle. Once again, students divided into grade level groups and created a WebQuest for their own students.

Assessing the Project

Teacher Concerns about Technology

In order to assess the level of teacher concerns related to the integration of technology as a change or innovation, the Stages of Concern About the Innovation Questionnaire (SoCQ) was administered. The SoCQ sought to identify changes in teacher concerns about technology and was administered just before the first workshop and just after the last workshop. The instrument is based on a seven stage developmental model: (0) awareness; (1) information; (2) personal; (3) management; (4) consequence; (5) collaboration; and (6) refocusing (Hall, George, and Rutherford, 1979). The SoCQ consists of thirty-five questions each designed to reflect concerns relevant to one of the seven stages of the model. Respondents rate the degree to which each item reflects their feelings using an eight point Likert Scale that ranges from "not true of me now" (0) to "very true of me now" (7).

The 35 statements were collapsed into the seven stages identified by the manual. A paired t-test was performed for each stage, using an alpha of .01. Results of the analysis are presented in Table 1. For facilitators, t-tests revealed a significant decrease in reported concerns related to Stage 1 – Information, reflecting declining concerns as the mean rating moved toward "not true of me now" for such items as "I have a very limited knowledge about technology." For participants, t-tests revealed significant decreases in reported concerns related to Stages 0 and 3. This reflects

declining concerns as the mean rating moved toward "not true of me now" for such items as "I don't even know what technology is" (Stage 0) and "I am concerned about my inability to manage all that technology requires" (Stage 3).

Table 1.
Reported Stages of Concern – Paired t-tests

	Pretest Mean	Posttest Mean	t-value	p
Facilitators				
Stage 0: Awareness	8.1	5.5	1.89	.091
Stage 1: Information	26.7	22.1	3.21	.011*
Stage 2: Personal	26.0	22.1	2.01	.075
Stage 3: Management	18.5	17.1	.79	.451
Stage 4: Consequence	28.8	27.6	1.35	.211
Stage 5: Collaboration	29.2	30.4	-.69	.507
Stage 6: Refocus	22.2	23.6	-.59	.567
Participants				
Stage 0: Awareness	11.1	6.8	4.30	.000*
Stage 1: Information	25.8	23.3	1.80	.083
Stage 2: Personal	25.7	24.2	1.12	.272
Stage 3: Management	20.1	16.4	3.37	.002*
Stage 4: Consequence	29.1	28.2	1.24	.228
Stage 5: Collaboration	25.2	25.8	-.42	.678
Stage 6: Refocus	21.8	23.2	-1.66	.110

*$p < .01$

Although there were no other significant changes in levels of concern, Figures 1 and 2 show that while concerns related to Stages 0 through 4 decreased during the project concerns for Stage 5 – Collaboration and Stage 6 – Refocusing increased. This suggests that both facilitators and participants were shifting from an exclusive focus on the impacts of technology itself and toward concerns about maximizing technology's effects" (Stage 5) and modifying the use of technology based on the experiences of students (Stage 6).

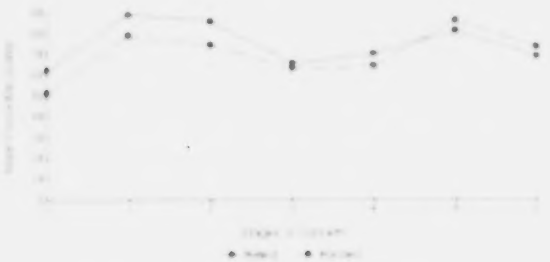

Figure 1. Mean Percentile Scores for Facilitators

Teachers' Use of Technology

In order to determine if teacher use of technology changed as a result of participation in the Goals 2000 project, a survey was administered with the SoCQ. Attendees' responses suggest subtle but important shifts toward more use of technology with 70% of the facilitators reporting daily use of technology and nearly half (46.2%) of the participants reporting daily use of technology. When asked which software applications they used, facilitators shifted from 70% reporting never using databases to 60% reporting occasional use. Thirty percent of the facilitators reported never using the Internet with students at the start of the project while 60% reported using it often at the end of the project. For participants, there were important shifts in the use of word processors (42.3% reporting often) and the Internet (from 57% reporting never at the beginning to 26.9% reporting occasional use). When queried about their interactions with their peers related to technology, the participants made few changes. Conversely, for the facilitators, there were changes particularly in the category of "never." Seventy percent of the facilitators reported never working with other teachers to design technology using curriculum before the workshops but only 10% reported never at the end of the project. Fifty percent said they never worked on technical problems related to software with others at the project's beginning while only 10% said never at its conclusion. For the facilitators in particular, these shifts seem consistent with the increased desire to work collaboratively with others expressed above.

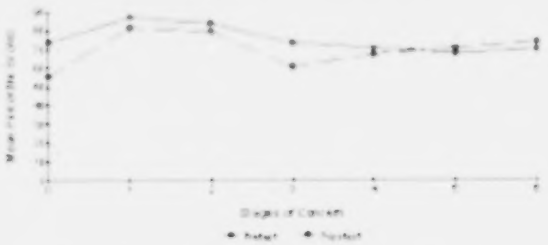

Figure 2. Mean Percentile Scores for Participants

At the completion of the final workshop, an open-ended questionnaire was distributed with the posttest SoCQ and the survey of technology use. The questionnaire asked four questions. The first question asked facilitators and participants what they had learned about technology. Eighty-six percent of the combined group mentioned learning about a variety of software applications, 27% stated that doing/using is knowing, 21% wrote they were less fearful or that technology was less mysterious, 13% mentioned that using technology was fun, and 10% wrote that using trial- and-error and taking chances with technology was important.

The second question asked facilitators and participants what generalizations they could make about teaching and learning with technology based on their experiences during the workshops. Forty-four percent wrote that learning-by-

doing and exploring instead of lecture and presentation was important. Combining responses for the two groups resulted in forty-two percent stating they now believed that the focus should be on content not on technology and that project-based or problem-based learning was best. Thirty-three percent mentioned the importance of hands-on learning, and 25% wrote about the value of collaboration and learning with a partner. Twenty-three percent defined the role of the teacher as facilitator rather than director. Thirteen percent mentioned that the models used during the workshops could be adapted to their own classroom.

The third question asked facilitators and participants to suggest any changes in the workshop structure they would recommend. Three respondents mentioned providing free lunches, improving the air conditioning, and doing fewer surveys respectively. All of the remaining 45 workshop attendees stated the need for more technology learning workshops. They recommended extending the model to include more teachers and asked for more opportunities for themselves. In addition, thirty-five percent of respondents stated the need for more technology access in their own teaching contexts.

The fourth question asked facilitators and participants what activities they had engaged in with other colleagues. All the participants either left the question blank or wrote "nothing yet." The 60% of the facilitators, on the other hand, stated they had shared ideas with other teachers, and 40% reported they had either presented other workshops or collaboratively designed lessons with colleagues in their own building.

Conclusions

Can six workshop days make a difference in teacher attitudes and uses of technology? The answer is mixed. Looking at the data, it is possible to conclude that the Goals 2000 workshops changed teachers in subtle and emerging ways. The workshops decreased the information concerns of facilitators and the awareness and management concerns of participants. Data suggest that attendees use of technology to support the learning increased. Facilitators, who were placed in the role of teachers of teachers generalized that role and worked with colleagues outside the structure of the Goals 2000 project. Yet, this data points only in the direction of change, not toward substantial or deep changes in educational practices. As the teachers themselves recognized, more is needed – more technology education for teachers and more technology for student use. This project set a process in motion. It demonstrated that a little can go a long way. To fully realize the beginnings of change set in motion by the Goals 2000 project, however, it will take more before hopes for district-wide technology integration become reality.

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Technology Inservice: A Powerful Change Force

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Introducing technology into schools is a significant challenge because it requires change in curriculum and teacher practice. The Office of Technology Assessment (1995) concludes that for computer technology to become an integrated part of schools a high-quality preparation of staff is needed. Rutherford and Grana (1995) suggest that resistance to change is caused by an array of faculty fears. Included in these are "fear of change, fear of time commitment, fear of appearing incompetent, fear of techno lingo, fear of techno failure, fear of not knowing where to start, fear of being married to bad choices, fear of having to move backward to go forward, fear of rejection or reprisals" (p. 512). Several studies (Strudler, Quinn, McKinney, & Jones, 1995; Willis, Willis, Austin, & Colón, 1995; Roberts & Ferris, 1994) show that one of the problems with integrating technology into any curricula is the teacher in the classroom. There are a number of reasons for this, such as computer illiteracy, computer phobia, disinterest, lack of equipment, and lack of support personnel. Rapid technology changes make it difficult for faculty to stay current and using technology is frustrating. In addition, using technology is risky and faculty find it hard to take risks.

Teacher inservice can help teachers overcome computer illiteracy and phobia, but may not always help teachers integrate computers into their curriculum. Inservice programs that include full-time, site-based training that focuses on the individual needs of the teachers have a better chance of achieving the desired change of technology and curriculum integration (Pappillion & Cellitti, 1996). The changes teachers must make take time and must reflect the concerns teachers have about technology and the curriculum.

This paper reports on a collaborative effort between a university teacher education program and a public junior high school in a program to integrate technology into the school curriculum. The focus is to document how this collaborative effort reflects Michael Fullan's (1993) eight basic elements of change in the schools. In his study of educational change, Michael Fullan (1993) concludes that "change is a journey of unknown destination, where problems are our friends, where seeking assistance is a sign of strength, where simultaneous top-down and bottom-up initiative merge, where collegiality and individualism co-exist in productive tension." (p. viii). He describes change as a move of educational systems toward learning environments where change is a part of daily work, not the latest policy decision:

- You can't mandate what matters. The more complex the change the less you can force it.
- Change is a journey not a blueprint. Change is non-linear, loaded with uncertainty and excitement and sometimes perverse.
- Problems are our friends or conflict is essential. Problems are inevitable and you can't learn without them.
- Vision and strategic planning come later. Premature visions and planning blind.
- Individualism and collectivism must have equal power. There are no one-sided solutions to isolation and groupthink.
- Neither centralization nor decentralization works. Both top-down and bottom-up strategies are necessary.
- Connection with the wider environment is critical for success. The best organizations learn externally as well as internally.
- Every person is a change agent. Change is too important to leave to the expert, personal mind set and mastery is the ultimate protection. (p. 21-22)

Research Design

The focus of this research project was to investigate an inservice program aimed at developing curriculum that integrates technology into instruction that includes the problem-solving process. The university-public school partnership had defined inquiry and professional development as two of its primary functions. The two partners were jointly committed to helping teachers develop new curriculum that integrated technology (O'Neil, 1992; Broughy, 1992). Participants had discussed the importance of defining problems for students to solve as a part of the inquiry process and that the problems needed to be authentic and real-world in nature. Learning had been

discussed as an on-going process of construction, generation, and creation of meaning enhanced by interaction with other learners in cooperative and interdependent efforts. The design was based on one similar to that reported by Solís (1997).

An earlier project began in a school with only one teacher being mentored by a university professor. The professor spent time helping a classroom teacher learn to use computer programs that were available at the school. The teachers and students were introduced to a spreadsheet program as a tool in data collection and analysis problems. The students were then placed in groups of four and asked to design and complete a problem that would require the collection and analysis of data. The professor worked with both the students and the teacher to select the problem and analyze the data (Wentworth, 1996).

As the program expanded to the whole school, teachers began to think about curriculum that could be enhanced with technology. Participants worked with software that enabled them to integrate technology into their curriculum with minimal acquisition of new skills. Initial work began in group sessions with teachers from one or two disciplines and moved to the classroom when the teachers had planned instruction that needed technology support. The teachers were encouraged to move at their own pace as they used the technology in their classrooms. Reflection and evaluation was an on-going process to keep the project on course, given the increased numbers of persons involved. The approach was similar to the one proposed by Resnick (1996) in his proposal of distributed constructionism. Their worked was shared with others in the group and with their students. In the process of sharing and teaching, participants rethought their work and learned from each other.

The professor, as part of a larger program of teacher education, was also involved in the supervision of student teachers in this particular school. The teacher education program was changing this same year to include university course work for the student teachers to be done at the school. The professor spent at least two full days a week in the school working with student teachers and with classroom teachers on the development of their integrated curriculum. Having the student teachers in some of the classrooms allowed some teachers freedom to develop lesson ideas and help in the computer lab with other teachers who did not have student teachers in their classrooms. Along with the integration of technology in the classroom, the teachers were placed in teams to integrate across subject areas. As teachers produced lessons that integrated in this way, they provided them to the district.

Several lesson plans were created and implemented by the teachers. Two examples are listed here:

1. You were very interested in the weight lifting at the Atlanta Olympics. You thought about the size and weight of the participants and the amount of weight they lifted. How would you determine which weight class lifted the highest weight as compared with their body size? Which person would you declare as the "strongest man on earth" based on this?
2. You are interested in how the Olympic games will effect the area of Salt Lake City in the year 2002. What areas of change do you expect to find? What data will you collect before the games? What data will you collect after the games? What predictions will you make based on the information you can collect about the Olympic games in Atlanta?

Question 1 integrates both mathematics and physical education. Question 2 integrates social studies and mathematics. Teachers collected data on these questions and then began to define questions for their students as examples. As the teachers implemented these in their classrooms, the students began to ask their own questions. The teachers were excited to see students engaging in inquiry in this way.

The researcher, the teachers, and students kept research logs of the projects from conception through final report. The researcher kept an account of the types of problems designed by the teachers, the discussion about the data required to answer the question, the use of technology to solve the problem, and the final analysis and representation of the data. Throughout the project, the researcher interviewed the teacher and students about their work, asking questions to get at their problem solving and their views about the use of technology as part of the problem-solving process: how did they select the data to collect, how did the technology aid in the analysis of the data, what conclusions were drawn from the results. The researcher also kept a journal of frustrations and successes experienced by the teachers and students.

Results

The data collection and data reduction techniques were based on methods perhaps most specifically discussed by Miles and Huberman (1984). The transcribed interviews, journals, and logs were coded as to their connection to Fullan's eight elements of change.

You Can't Mandate What Matters

Some teachers were unwilling to participate in the project because it was not required by the district or principal. However, once the initial inservice took place most teachers were excited to begin designing curriculum that would include the technology they had seen. Eighty-seven percent of the teachers in the school participated in the inservice group sessions; 95% of those teachers designed curriculum that integrated technology. Only 38% of

those teachers actually implemented the lesson with students. Many of the others said they planned to try it the next year when they could plan for it more easily.

Change is a Journey not a Blueprint

The university professor and the school teacher had learned from their experience of the first year that defining the problem presented to the students was a key element to successful integration projects. They did not impose their experience on teachers but encouraged them to think of specific questions to ask their students. The method for using technology was not dictated but suggested to the teachers.

Problems are Our Friends

Four months into the school year, the software was still not available, and the school learned that it was not to be donated, but would need to be purchased. Software was not licensed on all machines initially so work could not begin as early as had been hoped. The new computer lab was not wired on schedule, which also delayed the inservice. The only good that came from this is that there was time to become familiar with teachers in their classroom, what their expectations were for technology, and to problem solve. However, the fact that many teachers did not have time to implement their lessons was a direct result of this problem. Many of the teachers did implement technology the next year with perhaps more help from each other and less from the university specialist. The benefit here was that teachers learned to share ideas and expertise and not depend on an outsider for help.

Vision and Strategic Planning Come Later

Curriculum that includes technology was seen as an on going process that would develop over time. It was felt that more complete integration would come after teachers had become familiar with the software and exposure to inquiry learning. After the work with one teacher, then with one faculty, a vision for this type of inservice began to develop. The university professor and the teachers worked to think through the vision.

Individualism and Collectivism must have Equal power

"One of the things I've liked about this is that [the university professor] has not told us everything to do," said one participant. "I was able to plan things for my classroom the way I wanted them and then she tried to help me make them work for what she was doing." Teachers were learning from each other things they planned for their classrooms. The collective concern was that technology become a part of curriculum. The individual concern was that teachers be allowed to select lessons that were appropriate and interesting to them, not some larger agenda. These two concerns were given equal weight throughout the project.

Neither Centralization nor Decentralization Works

The school and the university shared in many discussions about design, implementation, and analysis of this project. No one group took away from the other. The university-public school partnership had been on going for several years and trust had been established between both organizations. Relationships had been built over a long period of time. Having a teacher at the school who had been through the process was a great benefit as well. She was able to help teachers when the professor was not at the school. She supported their ideas, and helped them prepare work that integrated content areas.

Connection with the Wider Environment is Critical for Success

Both the nature of collaboration among school departments, and the type of lessons designed by teachers indicate connections to the wider environment. The inservice was done with groups of teachers by departments that would naturally have similar content. Two examples of questions to ask students to begin the projects were about the Atlanta Olympics and the Olympics coming to the local community in 2002. Integration of content areas and local issues support the value of connecting to the wider environment.

Every Person is a Change Agent

"I can't believe how much help we've been to each other," commented one teacher. "Having us learn this, then help each other integrate it into the classroom has been great." When teachers take on the role of change agent, they share in the creation of the vision. They begin to believe that they are experts. They lose their fear of change.

Conclusions

By making technology a construction tool in curriculum development, teachers were able to see quick results and impact in their classrooms. This inservice program designed as a partnership between a public school teacher and a university instructor seemed to support Fullan's eight lessons of change. Very few comments and events were given just one code. "Problems are our friends" linked to the lesson that "change is a journey not a blueprint" the most often. Many problems occurred, but most of them were not considered "friends" by the participants, even when they did lead to additional inquiry and new understanding. "You can't mandate what matters" stood alone more often than other lessons. When it was linked to other lessons, the most common was "vision and strategic planning come later." "Individualism and collectivism must have equal power" and "neither centralization nor decentralization works" seemed to occur together. They were often linked to "connection with the wider environment is critical for success." "Every person is a change agent" paired with every other lesson to some extent. This lesson seemed to be central to the inquiry process.

Teachers worked on the same software and began together, so they supported each other in the learning curve. Teachers were able to consider integration of content area as they included technology in their curriculum. Having a university professor at the school helped the teachers initially try the technology. They worked together with the students to learn the software, and then determine how it could enhance the curriculum. As the year progressed, the professor spent less time teaching how to use the technology and began to help teachers rethink instruction and content. New types of problems were considered because the technology could help the student investigate and seek out answers.

Both students and teachers enjoyed experimenting with the technology. They worked together to define questions that had significance for the content of the curriculum. The questions were complex and interesting, requiring many days to complete. Teachers and students worked several days defining the problem and deciding on the data required to answer the question defined by the problem. Teachers and students felt like co-investigators and learners. The teachers began to feel confident in their abilities to use the technology. They began to trust the students to learn specific content as they defined their own problems.

As the program progressed, conversations moved from the mechanics of designing and implementing technology into the classroom to more substantive issues of learning and teaching, school renewal and professional development. Teacher renewal (inservice) was a natural outgrowth of teaming and could lead to a new way of looking at professional development as a natural part of teaching and teacher education. This pilot has implications for a new way of thinking about professional development. It becomes an ongoing learning model instead of an inservice course taken after school, on Saturday, or during the summer months. The collaborative nature of the program can provide a road map as future programs continue to explore professional development through inquiry.

As new inservice programs at additional sights are begun, participants must remember Fullan's eight lessons of change. Visions and strategic planning must come from all the participants. New participants will have their personal concerns about what matters. Individual concerns must not be lost to collectivism. The participants will need to come together to negotiate their program, just as the participants in this program did. This pilot should not be used as a strict blueprint, but only as a road map to guide the journey. The university-public school partnership should continue to provide the necessary opportunities of such work to take place. The partnership should continue to evaluate the importance of collaborative learning through inquiry as a bases for school renewal and professional development.

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EDUCATIONAL COMPUTING COURSE

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There are many changes underway in the educational computing class and all of the papers this year reflect the changes in some way. The recent NCATE report, *Technology and the New Professional Teacher: Preparing for the 21st Century* (available on-line at www.ncate.org) states that "recent research indicates that most teacher education programs have a long way to go" (p. 4) and that "the nation's teacher education institutions must close the teaching and learning technology gap between where we are now and where we need to be" (p. 3). They also say that teachers need to be aware of the new technologies, the new role of the teacher, and how these will interact in the classrooms of the future.

Another important point made by the NCATE report that directly impacts the educational computing class is that the teachers who teach teachers today need to be modeling technology use and encouraging the future teachers to be risk takers and lifelong learners. We should be encouraging our students to embrace the new technologies and the new challenges they present. This requires change in several ways. The NCATE report explains it this way – "What is required is a transformation of the culture of teacher education, one in which technology is seen as changing relationships between students and teachers and between learners and knowledge" (p. 8).

The first paper in this section *Design of a Computer Literacy Course in Teacher Education* by Leh looks at the design of the introductory computer courses. The design includes structure, content, and whether it is a required course or not. The next three papers discuss attitudes and learning in the educational computing course. *Teaching Pre-Service Teachers Technology: An Innovative Approach* by Gunter, Gunter, and Wiens describes research done to restructure the educational computing course in order to make a difference in students' attitudes. *Action Research in the Educational Computing Class* by Bump defines action research and describes the research done in the educational computing class to gather feedback and reflection from the students in order to enhance and improve the course. Learning about Learning in an Introductory Educational Computing Course by Niederhauser, Salmen, and Fields examines how this course can provide future teachers with an opportunity to examine learning theory in the context of the class and apply it when they become teachers.

The last three papers describe actual projects and products that have been completed by students in the educational computing class and how these impact their training as a professional educator. *Instructional Strategies for Integrating Technology: Electronic Journals and Technology Portfolios as Facilitators for Self-Efficacy and Reflection in Preservice Teachers* by Kovalchick, Milman, and Elizabeth describes the use of electronic journals and technology portfolios as an instructional strategy in a reflexive approach to learning. *Anchored Instruction in Preservice Educational Technology Classes: A Research Project* by Bauer tells of the need for empirical research supporting the claim that anchored instruction is an effective approach to use to prepare teachers for integrating technology in the classroom. *Teaching "How to" Technologies in Context* by Leigh demonstrates the use of situated learning and constructivist strategies in the educational computing class.

NCATE will publish another report in the year 2000 which will "introduce its latest set of accreditation standards which will undoubtedly raise the bar for the use of technology in teaching and learning in schools of education" (p. 3). As teacher educators we should be proactive and fearless in our approach to teaching the teachers that hold the key to the development of their students into lifelong learners. The papers in this section suggest several ways in which this process can be started.

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Design of a Computer Literacy Course in Teacher Education

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Technologies of the 20th century have changed how we live, how we conduct business, and how we communicate with each other. Of course, they also affect the way we teach and the way we learn. The business world demands schools to prepare students for effective use of technology in their future work places. The president and vice president of the United States expect every child in our nation to feel comfortable on the Information Superhighway. In addition, computer-to-student ratios have dropped consistently from 1:50 in 1985 to 1:20 in 1990 to an estimated 1:9 in 1997 (National Council for Accreditation of Teacher Education [NCATE], 1997).

All of these facts indicate that new technology is affecting our classroom practice and also the culture of the schools. This technological influence is challenging our teachers and will challenge the two million new teachers who will be hired over the next decade. The new teachers should feel comfortable with the new culture of the schools and be ready for the requirements of teaching in the "Information Age." Are our teacher education programs preparing the two million new teachers to face the challenges? Unfortunately, most programs "have a long way to go" (NCATE, 1997, p. 1).

The NCATE task force assists colleges of education by summarizing the technology skills and knowledge which a new professional teacher needs to acquire during the preservice training: new understandings, new approaches, new roles, and new attitudes (NCATE, 1997). The teachers need to understand the deep impact of technology on the nature of work, on communication, and on the development of knowledge. They must use a wide range of technological tools and software as part of their own instruction. They must help students in the use of technology to gain information which goes beyond textbooks and teachers. In addition, they should be fearless in the use of technology and be life-long learners.

To respond to the professional call, several teacher education programs have been offering computer courses to help the future teachers. The following research focused on one of the computer courses, an introductory computer literacy course, which is commonly offered at colleges of education. The study reports how the course is taught and what is taught in the course at different universities.

The Research Study

The study was designed to investigate the structure and content of the introductory computer literacy course at colleges of education at universities in the United States. The structure and content of the course were examined.

Research Problem

Due to the need for the new professional teachers, colleges across the nation are being equipped with technological tools. Programs preparing teachers to utilize these devices for enhanced learning still need to be developed and adjusted. Many universities help their students take advantage of these new tools by offering introductory computer literacy courses. Unfortunately, there has been little discussion on what skills and knowledge teachers must have to take advantage of the new technological tools (Old Dominion University, 1997).

Research Questions

1. What structure is used for the course?
2. What skills are students required to master in the course?
3. What knowledge do students need to acquire in the course?

Procedures and Methods

Nine universities were selected for the study: Arizona State University, Florida State University, Harvard University, Indiana University, Massachusetts Institute of Technology, Pennsylvania State University, Stanford University, University of Virginia, and Yale University. These universities either are considered to be prestigious universities or have the reputation of offering an outstanding educational technology program.

First, phone calls were made to each university to find a course which prepares undergraduate education students

on using technology for their future teaching career. During the same time, copies of the course webpages were obtained.

The initial phone interviews and webpage search revealed that each university has its own way of preparing their students for the use of technology in instruction. Some universities do not have education programs for undergraduate students, such as Stanford University. Stanford University does offer a course entitled Information Technology in the Classroom (Education 224), which is designed to give teachers in the Stanford Teacher Education Program (STEP) a foundation for using technology in their teaching (Stanford University, 1997). However, the course is not considered to be an introductory course because students in the class are expected to already know some computer applications, such as word processing and e-mail. Some other universities do not offer independent education technology courses; instead they integrate technology into other education courses, such as method or foundation courses. Yale University is an example of these universities.

Therefore, the research focused on four of the universities which offer a similar introductory computer course: Arizona State University (ASU), Indiana University (IU), Pennsylvania State University (PSU), and University of Virginia (UV). EMC 321: Computer Literacy (Arizona State University, 1997) offered at ASU, W200: Microcomputers in Education (Indiana University, 1997) offered at IU, INSYS 400: Introduction to Instructional Technology for Educators (Pennsylvania State University, 1997) offered at PSU, and EDLF 345: Introduction to Computers & Media in Teaching (University of Virginia, 1997) offered at UV were selected for the research. Phone call interviews were conducted to obtain detailed information on the specific course at each university and the course webpages were downloaded for analysis.

The data collection and analysis focused on structure and content of the courses. How the course is taught and what is taught at each university were categorized and analyzed.

Results

The four introductory computer courses selected for the research are similar to each other. However, the structure and content of the courses still vary from one university to another.

Structure: The introductory computer course is a required course for students at the College of Education at ASU and IU, but is not required for students at PSU and UV. At PSU, several computer courses are offered to undergraduate education students, and they may choose any course. According to the professor who was interviewed, it is not necessary to require this specific course because other courses are also available. In addition, the course at PSU can be a one-credit, two-credit, or three-credit course depending on the interest of the individual student. Similar to PSU, several computer courses are offered to undergraduate education students at ASU. In contrast to PSU, the course is required at ASU.

At ASU, the course contains lecture and lab. The lecture is conducted in a big lecture hall which can accommodate more than 150 students. Students learn the concepts with approximately 100 other students in the big lecture hall. The lab is conducted in small groups in a computer lab with approximately 25 computers. Students have hands-on experience in the computer lab. Students have two instructors, one for the lecture and one for the lab. The lecture syllabus and the lab syllabus match each other. The course instructors use identical syllabi and conduct weekly meetings to maintain consistency of the course. Students take identical mid-term and final examinations. With two or three lectures, this structure allows the same course content to be taught to more than 300 students simultaneously.

At IU, the course is structured differently. There is no separation into lecture and lab sections. The course is conducted in a computer lab where the instructors teach both computer concepts and skills. The course instructors use similar syllabi. However, since many instructors are teaching the class and since about 500 students are taking the course, an instructor of the course, addressed in a phone interview, said that the course content might vary slightly because each individual instructor might emphasize different concepts or skills.

Content: The course contains concepts and skills at all four of the universities. Concepts include knowledge of computer technology and design, such as basics of hardware and presentation design. The students are expected to master skills such as word processing, spreadsheet, and database. ClarisWorks and MSWorks are commonly used for word processing, spreadsheet, and database. PowerPoint is frequently employed for presentation and HyperStudio for multimedia. Word, Excel, and FileMaker Pro are used by IU.

Students at all four universities learn concepts and skills of word processing, spreadsheet, database, e-mail, and webpage development. In addition to these skills, students at IU, PSU, and UV learn multimedia and presentation applications. Instructors at PSU help students integrate technology into instruction by teaching them how to write a lesson plan. Instructors at UV encourage students to participate in outside activities by giving them field assignments.

Compared to students at IU, PSU, and UV, students at ASU learn fewer applications in the course but spend more time on each application. Their course only emphasizes word processing, spreadsheet, database, and webpage development. Since other computer courses are available at the College of Education at ASU, the students are encour-

aged to learn additional computer skills from the other computer courses.

Table 1 lists main concepts and skills the course involves in each university. As mentioned earlier, an instructor at IU might focus on some skills that might not be emphasized by another instructor who teaches the same course. The course at PSU can be a one-credit, two-credit, or three-credit course. A student, who takes the course as a one-credit course, spends less time and learns fewer computer applications than a student, who takes it as a three-credit course. For example, multimedia and HyperStudio are not taught to the former students, but only to the latter students. Therefore, a student might not learn all concepts and skills listed on the following table depending on his/er university structure and instructor.

Table 1.
Concepts and Skills Involved in the Introductory Computer Course

	ASU	IU	UV	PSU
Concepts				
Word Processing	•	•	•	•
Spreadsheet	•	•	•	•
Database	•	•	•	•
Multimedia	•	•	•	•
Presentation & Visual Design	•	•	•	•
Lesson plan & Instructional Design		•	•	•
Netsearch	•	•	•	•
Software evaluation		•	•	•
Skills				
Word Processing	•	•	•	•
Spreadsheet	•	•	•	•
Database	•	•	•	•
E-mail	•	•	•	•
Multimedia		•	•	•
Presentation		•	•	•
HTML & Web Development	•	•	•	•

Note. ASU = Arizona State University, IU = Indiana University, PSU = Pennsylvania State University, UV = University of Virginia

Implications

Preparing education students (future teachers) to teach in the Information Age is necessary. The students must understand their new roles, use new approaches, and have new attitudes. Being able to use technology, especially computers, and to integrate them into instruction is essential. Every teacher education program has to prepare our students for the technological change in the society and in schools.

A teacher education program has to either offer educational computer courses, like at ASU and IU, or courses with technological integration, like at Yale University. It is more demanding to offer courses with technological integration than to offer educational computer courses because the former requires more faculty members of the program to be skillful with technology. Currently many faculty members at colleges of education are still in a stage of learning the use of technology.

Before the faculty are ready to teach courses integrating technology, the program must offer educational computer courses, especially introductory computer courses. If only one computer course is offered in a program, the course should be required for education students. If several courses are offered, students should select one or two of the courses to fulfill their program requirements.

Two structures were found to be employed for the course. The structure at ASU is organized, and the course content is very consistent. Students taking the course are guaranteed to be taught the same information. Since students learn computer concepts with about 100 students in a big lecture hall, they might learn less effectively compared to students in a learning environment with only 20 students. The structure at IU allows students to access a computer at any time in class; students might learn better in a small computer lab, rather than a big lecture hall. However, students might learn different information from different instructors even though they take the same course.

There are advantages and disadvantages to both structures. If all instructors of the course are willing to use identical syllabi and participate in regular meetings and if they are able to teach all concepts and skills listed on the syllabus, the IU structure is recommended to be used. If an instructor cannot meet the three requirements mentioned above, the ASU structure is helpful for maintaining the consistency of the course. In addition, the ASU structure allows graduate students with good computer skills to teach lab sections even though they might not be qualified to lecture for the course.

Regarding the course content, students can learn more software in a less sophisticated way or acquire fewer applications in a more profound way. An institute with only one computer course in its teacher education program is recommended to have the course include as much information as possible. In other words, students will be able to use word processing, spreadsheet, database, presentation software, multimedia application, e-mail, Netsearch, and develop a webpage at the end of the course. Hopefully, the basics they learned in the course will allow them to later expand their experience with computers. If additional computer courses are offered, the introductory course may cover fewer applications, but in greater depth.

Conclusions

Technology development is affecting our schools. Teacher education programs are required to prepare students to understand their new roles, use new approaches, and have new attitudes for teaching in the Information Age. An introductory computer course similar to the courses offered at the four universities of this research study is strongly suggested to be offered to students at each college of education. Different structures are employed at the universities. An institute should choose a structure that fits the institute and keeps the course consistent. Surely, the course content may be affected by the course structure and institutional characteristics. The course content at the four universities provides the education students with the computer concepts and skills which they are expected to know for their future teaching: word processing, spreadsheet, database, multimedia, presentation, e-mail, Netsearch, and integrating technology into instruction. An education student with these computer skills and knowledge will become a qualified teacher who can prepare the children in our nation to face the challenges of the modern world.

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Teaching Pre-service Teachers Technology: An Innovative Approach

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As technology has quickly been changing and revolutionizing the computer industry, education and educators have continued to have difficulty embracing the technology with open arms. Along with the availability and expanded capabilities of the computer and related technologies in the classroom, student attitudes toward computers remain a barrier in the learning process of technology (Clawson, 1996; Gunter, 1994; Gunter & Murphy, 1995).

Research has shown that a pre-service teacher's initial attitude toward technology may either positively or negatively impact their future use of educational technology in the classroom (Reznich, 1996). Faculty should be knowledgeable of the factors that could cause students to exhibit behavioral characteristics such as: computer anxiety, computer confidence, computer liking, and computer usefulness.

Faculty must understand that one of the strongest impacts on the educational process is that students' attitudes affect their process of learning. Educators must reevaluate their educational focus, thus leaning toward the use of technology with positive experiences for pre-service teachers (Clawson, 1996). Every effort to assure pre-service teachers' initial exposure to educational technology is positive and motivational should be made. Educators need to strive to light a fire and motivate pre-service teachers to understand the influence educational technology can have in their lives and classrooms.

A report published in 1997 by the National Council for Accreditation of Teacher Education (NCATE) titled *Technology and the New Professional Teacher - Preparing for the 21st Century Classroom*, stated "The nation's teacher education institutions must close the teaching and learning technology gap between where we are and where we need to be. Teacher education institutions must prepare their students to teach in tomorrow's classrooms (p i)."

The majority of pre-service teachers continue to enter institutions of higher learning lacking the positive attitudes, proper skills, and knowledge in the use of computers. All pre-service teachers should be competent in computer related skills. Students should be provided with the skills that will enhance their abilities to not only compete in a global economy, but survive well into the 21st century. To date, many institutions of higher education have failed to properly prepare pre-service teachers with positive experiences while learning the required technological skills. Furthermore, students have not been provided with insight into the potential educational technology can have on public education.

The federal government is investing $2.25 billion a year to provide high speed Internet access in all K-12 classrooms. By the year 2000, many K-12 classrooms will have access to the Internet. It is essential that Colleges and Schools of Education instruct pre-service teachers how to integrate the vast resources of the World Wide Web and related technologies into their classroom curricula. In addition, teachers need to understand the teaching processes that can be enhanced by using the computer and acquire evaluation skills for determining when to use the computer. Pre-service teachers need to learn how to assess the effectiveness of the computer when it is used in the instructional scheme. Institutions of higher education must develop motivational strategies to provide pre-service teachers with these evaluation skills.

Purpose of the Study

The purpose of this pilot study was to examine variables that could possibly influence attitudes toward learning and working with computers of College of Education pre-service teachers at the beginning and end of an introduction to educational technology computer course taught at the University of Central Florida during Summer 1997. The course used for this research was EME 1040, Technology for Educators. The variables examined in this study were computer attitudes and student perceptions. For purposes of this study, computer attitudes are identified as computer anxiety, computer confidence, computer liking, and computer usefulness (Gunter, 1994; Henderson, Deane, Barrelle, & Mahar, 1995; Loyd & Gressard, 1984).

The introduction to educational technology course was redesigned to incorporate innovative strategies for teaching pre-service teachers to use technology, teach with the technology, and find creative ways to help pre-service teachers to integrate technology into the curricula of their future classrooms. The researcher wanted to determine if these strategies could make a difference in pre-service teachers' attitudes toward technology after completion of the course.

Methodology and Instrumentation

The research design for this study was causalcomparative. Due to the nature of classrooms with intact groups, the causalcomparative method was used. Causes are studied after they have already exerted their effect on a variable. Otherwise known as ex post facto research, the causalcomparative method was utilized to explore the relationships among variables. Statistical tests used were t-tests and they were considered significant at the .05 level.

The instrument used for this pilot study was the Computer Attitude Scale (CAS) developed by Gressard and Loyd (1985). The CAS is a 40item instrument that is divided into four, 10item subscales: Computer Anxiety, Computer Confidence, Computer Liking, and Computer Usefulness.

The CAS has been successfully used with 7th12th grade students, college students, teachers, and administrators. To explore functional use of the CAS, Loyd and Gressard (1985) and Loyd and Loyd (1985) ran a study that indicated the CAS is reliable and valid for measuring attitudes. The coefficient alpha reliabilities were .89, .89, .89, and .95 for Computer Anxiety, Computer Liking, Computer Confidence, and the Computer Usefulness Subscales, respectively. A factor analysis revealed the subscales were sufficiently stable and the instrument could be used confidently and effectively in research and program assessment. The CAS has been tested through many studies to determine the stability of the CAS and subscales to determine their effectiveness in reflecting change in computer attitudes as a result of computer instruction and experience. The CAS was found to be sensitive to attitude changes resulting from computer instruction and experience.

Description of Sample

The sample for this pilot study were students enrolled in an introduction to educational technology course, EME 1040 Technology for Educators taught in the College of Education at University of Central Florida during Summer 1997. The sample utilized in this study were those students who completed both the CAS pretest and posttest. Twenty-nine students completed the pretest with posttest being completed by 26 students. After completion of the posttest, 26 students were matched by pretest to posttest. Therefore, the sample of students for this pilot study was 26. The sample consisted of 21 females and 5 male students of ages ranged from 19 to 46 with 76% being 26 years or younger. Twenty of the students in the pilot sample had attended a community college prior to entering the University of Central Florida. Eighty-nine percent of the students stated they had primarily learned technology on their own. Sixty-one percent had access to a home computer.

Description of the Course

Knowing that students enter the classroom with predetermined attitudes toward technology, faculty created innovative teaching techniques that were demanding but not threatening. Techniques and strategies were developed that created an environment for students that made learning technology not only relevant to the real world, but also fun.

Learners need to learn to use technology in a non-threatening environment. In order for students to embrace technology, they need authentic hands-on exercises, time, access, support, and resources to acquire ability through experience. Therefore, a major focus of the course was to provide opportunities for students to not only learn to use the technology but also learn to teach with technology.

The following is a summary of the basic curriculum and course issues that were considered fundamental to the overall success of the course.

Curriculum Issues. The course curriculum was completely redesigned prior to the start of the semester and was based upon state requirements, instructor experience, and formal inputs from regional K-12 teachers, K-12 technology coordinators, K-12 administrators, and College of Education faculty. During the first class session, each student was required to complete a detailed computer skills questionnaire that covered over 35 specific computer and educational technology skills. The course curriculum was modified after the first class session based upon the identified students' skill levels. The curriculum was also continually updated as the semester progressed based upon student performance, student comprehension, and new educational technologies. Traditional software tutorials were not used. Whenever possible, introduction and practice of software programs were immediately followed by practical application of the software in an educational setting. Integration of technology into K-12 classroom curricula was emphasized throughout the course.

High Impact and Low Threat. The course was considered by faculty to be a high impact class because hundreds of different specific educational technology and basic computing topics were covered. In addition, students were introduced to dozens of different software programs and the educational resources of the World Wide Web. All course activities and requirements were designed to be motivational and to empower pre-service teachers to use technology while at the same time creating positive experiences for all students. Traditional testing was not used. Instead, on-time and mandatory class attendance, hands-on exercises, out-of-class education related projects,

textbook reflections, and in-class presentations assumed the same role as traditional testing. Because of faculty emphasis of on-time class attendance, the average weekly attendance was over 97%.

Classroom Issues and Design. The course met once a week during the semester. Most class sessions were structured with approximately 40% non-traditional lecture format and 60% hands-on in a non-traditional computer lab. The lecture portion was considered non-traditional because all lectures were conducted in a modern multimedia classroom with a large screen projection system. Instructor created multimedia presentations were used for all lectures. In addition, the instructor continuously modeled educational and other technologies during teaching. The lectures included instruction on required traditional computer concepts, computer hardware, basic software programs, and dozens of educational implications of technology.

The computer labs were considered non-traditional for three reasons. First, all hands-on computer and software concepts practiced in the computer lab were first demonstrated by the instructor using the multimedia presentation system during the lecture portion of the classes. Second, all hands-on lab sessions were part of the scheduled class time and immediately followed the lecture portion of each class. As a result, new software concepts were still fresh on the minds of the students. Third, the course instructor was present and instructed during all lab sessions.

Continuous Emphasis on Key Basic Skills. Most students learn and tetain basic computer concepts only after continuous instruction and repetition. Many basic computer and software skills were continuously repeated by the instructor and practiced by the students many times to assure mastery and understanding. For example, techniques of file management were incorporated throughout the course. File management, a basic but crucial skill, was emphasized by the instructor and practiced by the students during every class session, resulting in hundreds of file management learning opportunities during the semester.

Findings

To determine the change in College of Education students' attitudes toward learning and working with computers after completion of EME 1040, Technology for Educators, t-tests were used to compare the pretest score to the posttest score to formulate the Computer Anxiety Subscale Gain, Computer Confidence Subscale Gain, Computer Liking Subscale Gain, and Computer Usefulness Subscale Gain. Statistically significant differences were found on all subscales. Information is summarized in Table 1.

The results of the t-tests revealed statistically significant differences between the pretest and posttest means on each of the four subscales. The findings indicate that after completion of the course students had less anxiety toward technology. Students' attitudes from the pretest to the posttest revealed statistical significant differences that occurred over the duration of the semester. Students in the College of Education were found to have a more positive attitude toward learning and working with computers after completion of the introduction to educational technology course. College of Education pre-service teachers had lower anxiety, more confidence, and found computers more useful at the end of the semester. An introduction to educational technology course made a difference in these students' attitudes toward computer technology.

Table 1.
Computer Attitude Scale Analysis of Variance Summary Table.

	Mean	t	Significance
Anxiety Subscale	4.91	5.407	.000
Confidence Subscale	3.73	4.490	.000
Liking Subscale	3.59	4.635	.000
Usefulness Subscale	1.61	3.064	.006

N=26 p < .05

Students were also asked to reflect on their experiences in the class through quantitative open-ended questions. Students expressed their feelings and perceptions of their experiences during the semester. Each of the following are direct quotes from several student responses, " Before this class I only knew the basics, word processing, and now I am confident I could build a database, spreadsheet, and Hyperstudio project"; "This class has built my confidence with computers!"; "I found myself wanting more and more to use technology in the classroom as a learning tool."; "I learned so much. I can not explain how important this class was for me and how it influenced me."

Conclusions and Recommendations

Analysis revealed a statistically significant change in computer attitudes of students over the semester. The research indicated that the introductory course was successful in significantly reducing the incidence of computer anxiety.

The introductory computer course is fundamental to a student's success with computer technology. Students in many education degree programs are not required to take any computer-related courses. Universities need to require at least one computer literacy course regardless of the student's program of study. Computers have infiltrated every aspect of our lives; therefore, all students should be prepared to enter the work force with adequate computer skills.

Therefore, the researchers concluded that computer anxious students could be taught in a way that could reduce computer anxiety. Thus, the more knowledge students gain

coupled with a positive experience in the classroom the lower their anxiety levels and the more positive their attitudes toward computers.

The researchers suggest the need for further research on computer attitudes in order to prepare students to possess information technology skills required to enter the work force. Whether in education, business, engineer or history, all degree programs need to emphasize the necessity of students possessing high-tech skills to compete in a world class global society. The changing of students' attitude involves persuasion and an understanding of the influences that determine a student's attitude. This study revealed that students continue to enter the university system with low skill levels and high levels of anxiety. From this pilot study, results confirm that how a course is taught can change students attitudes and perceptions of technology. Faculty must address these pre-existing attitudes and encourage and challenge pre-service teachers to not only learn how to use technology but how to integrate technology into their own classroom curriculums.

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Action Research in the Educational Computing Course

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The educational computing course has been part of the required courses for teacher certification for several years and has changed and evolved as a result of new practices and mandates through the years. I have taught this course at both the graduate and undergraduate levels for the past nine years and I have noticed an ever-increasing amount of competencies that are required of the education students. Not only are the students required to master the basic technologies, they are expected (in the same semester) to apply these technologies to lessons or classrooms situations. (This burden is being alleviated somewhat as other education classes begin to require technology use in the completion of assignments.) The students in these classes, when presented with the full to overflowing syllabus, express dismay, confusion, and despair, and compare their projected semester experience with trying to climb an impossibly high mountain with very little preparation and even less supplies.

Each semester I have tried to provide better and more detailed "maps" of the "mountains" with more "signs" and "guideposts" along the way. My training is in special education and I know how to break a job down into manageable and attainable pieces so the student will be successful. Also each semester I get feedback in an informal way and apply it in the next activity or the next semester's class. Each semester I find that some students have no problem "climbing the mountain and seeing the whole view from the mountaintop" (or, in other words, catch on quickly and have no problems with the activities and the course); whereas, other students have problems with each day of "climbing," or with the "path," or with their "supplies" for the "climb," or even with seeing where the "path" is leading them.

This led me to ask: "How could I formalize this process of action, reflection, and feedback?" and "Do certain types of learners do better with certain types of activities and certain structures for activities?". This paper defines action research, describes the action research done in the educational computing course for the Fall 1997 semester, and finally, discusses what was found and what action will be taken to improve the course.

What is Action Research?

Action research is a type of methodology that includes both action and research. The action refers to the change that will occur as a result of the research. The research refers to a "systematic effort to generate knowledge" (Deshler & Ewert, 1995). Dick (1997c, p 2) asserts that action research "allows you to develop knowledge or understanding as part of practice" and "allows research to be done in situations where other research methods may be difficult to use." Dick (1997c) suggests using action research if the researcher needs flexibility, or wishes to involve the participants, or desires to bring about change at the same time the research is being done. Action research "allows for systematic understanding to arise from activities which are oriented towards change. It has a capacity to respond to the demands of the informants and the situation in a way which most other paradigms cannot" (Dick, 1997c, p. 4). Reason and Heron's (1997) "collaborative inquiry" (another term for action research) is described as "a way of working with other people who have similar concerns and interests to yourself, in order to understand your world, make sense of your life and develop new and creative ways of looking at things. You also learn how to act to change things you may want to change and find out how to do things better" (p. 1).

In *A Beginner's Guide to Action Research* Dick (1997a) and his colleagues outline and discuss the major characteristics of action research:

- It is cyclic – similar steps tend to recur, in a similar sequence;
- It is participative – the clients and informants are involved as active participants in the research process;
- It is qualitative – it deals more often with language than with numbers; and
- It is reflective – critical reflection upon the process and outcomes are important parts of each cycle.

Action Research Procedures in the Educational Computing Class

Description of the Class

The educational computing class, CUIN 6320 Computers in the Classroom, at the University of Houston is a required course for teacher certification. Students must master

several technologies and learn to integrate them into the curriculum they will be teaching. All grade levels and subject areas are represented in the fifty students enrolled in CUIN 6320. Also all levels of computer expertise from novice to expert are present in the class, so the semester begins with basic information and activities used to introduce both operating systems, Macintosh and Windows 95. Several required activities are included in the curriculum that introduce students to word processing, draw, paint, desktop publishing, email, the world wide web, web page development, presentation software, and multimedia. Students are then required to do four projects that expand their knowledge about four of the technologies. The last requirement is a teaching unit in which at least three of the technologies have been integrated.

Methodology and Instrumentation

As part of the midterm the students were given two surveys and a series of questions. Preceding this were discussions about learning styles, learning preferences, and action research. The students were told that their answers would be compiled, analyzed, and utilized to improve the course. They were encouraged to be thoughtful and truthful in their answers and that full credit would be given for the completed assignment. The two surveys that were given were the Gregorc Style Delineator (Gregorc, 1985) and the *Productivity Environmental Preference Survey* (Dunn, Dunn, & Price, 1996). The Style Delineator is based on four quadrants that represent how a person perceives the world (abstract or concrete) and orders that information (sequential or random). A person's learning style will be dominant in one of the four quadrants with the results being Abstract Sequential(AS), Abstract Random(AR), Concrete Sequential(CS), or Concrete Random(CR). Research shows that there is significantly greater chance that graduate students will be Abstract Sequential (Cromwell, 1996) and that they like to dig into assignments, work alone, and organize work in large chunks to see the total picture (Andrews & Wheeler, 1994). Andrews and Wheeler (1994) also found that Concrete Sequentials tended to prefer traditional methods of instruction with deadlines and preselected assignments; that Abstract Randoms liked working in groups, creative scheduling, and less specific assignments; and that Concrete Randoms preferred to choose their products, methods, and due dates in a flexible framework.

The learning preferences survey shows preferences such as environmental (noise, light, temperature), emotional (motivation, persistence, responsibility), sociological (individual or team), and psychological (perception, intake, time) (O'Connor, 1997). Using a preference survey is a "useful first step toward analyzing the conditions under which an adult is most likely to produce, achieve, create, solve problems, make decisions, or learn" (Price, 1996).

The third part of the midterm consisted of several questions that the students were to thoughtfully answer. For the sake of space the questions will be listed in the results section.

After the midterm was collected and analyzed, the information gained was used to adapt and modify the upcoming assignments and class time. The students then had more time for reflection and feedback as we progressed through the class.

Results and Findings

Out of the 50 students that were surveyed, 38% were Abstract Sequential, 28% were Abstract Random, 20% were Concrete Sequential, and 14% were Concrete Random. Table 1 shows the percentage of each of the four learning styles and their preferences on a sampling of the questions from the Productivity Environmental Preference Survey.

Reflective Questions. The following questions were analyzed by the four learning styles groups.

- What was your most successful previous learning experience? (not in this class) Why? The AS group described experiences in which new techniques and creative methods were introduced and used; active learning at their own pace was allowed; teachers treated students as individuals and were accessible to students; and there was much group work. The CR group described experiences that were structured informally and had lots of choices and hands-on activities that related to the real world and to their experiences. The CS group described experiences that included challenging classes, in-depth reading, concrete demonstrations, thought-provoking discussions, and direct and immediate application of the lecture concepts. The AR group described experiences in which they were totally immersed in a Spanish-speaking environment; experiences where they had to learn everything by themselves; experiences in which they observed and learned from others; and experiences that utilized higher-order thinking and had lots of structure and strict deadlines.
- What was your least successful previous learning experience? (not in this class) Why? The AS group described experiences in which there was no interaction; there were lots of facts to be memorized; there were vague directions; and individual ideas were rejected. The CR group described experiences that were boring, vague, and consisted of lectures and notetaking. The CS group described experiences that included teachers with negative attitudes, extensive reading, holistic learning, no guidance or assistance, and no opportunity to manipulate the concepts to get the required results. The AR group described experiences in which they learned something that they could not apply or practice; they also described boring lectures and large classes.

Table 1.
Results of the preference survey.

	CS	CR	AS	AR
1. I prefer working in bright light.	100%	71%	84%	71%
I prefer to work where lights are shaded.	0%	29%	16%	29%
2. I can block out noise when I work.	30%	43%	58%	79%
Noise keeps me from concentrating.	70%	57%	42%	21%
3. I prefer cool temperatures when I work.	50%	14%	53%	64%
I often wear a sweater or a jacket indoors.	50%	86%	47%	36%
4. I can think better lying down.	20%	43%	11%	0%
I can concentrate better when I sit up.	80%	57%	89%	100%
5. I feel I am self-motivated.	80%	86%	89%	79%
I work better when someone is going to check up on me.	20%	14%	11%	21%
6. People remind me to complete my work.	0%	14%	5%	7%
I usually complete tasks that I start.	100%	86%	95%	93%
7. I prefer the teacher set deadlines.	60%	71%	26%	79%
I like to work at my own pace.	40%	29%	74%	21%
8. I like to work alone.	90%	100%	79%	64%
I like to work with several colleagues.	10%	0%	21%	36%
9. I remember what I hear.	20%	0%	11%	21%
I remember what I see.	80%	100%	89%	79%
10. I learn better with written directions.	90%	100%	95%	93%
I learn better when someone reads the directions to me.	10%	0%	5%	7%
11. I like to work with my hands.	60%	43%	42%	86%
I like to think about problems to solve.	40%	57%	58%	14%
12. I like to snack when I'm working.	70%	86%	63%	57%
Eating while working would distract me.	30%	14%	37%	43%
13. It is easy for me to concentrate late at night.	40%	71%	63%	50%
I work best early in the morning.	60%	29%	37%	50%

- What do you consider to be your major blockages to learning? The AS group said distractions, time, anxiety, lecture classes with no opportunity to practice, comprehension of written material, lack of desire, inadequate background, getting started, disorganization, boredom, and procrastination. The CR group said lack of interest, no hands-on training, low concentration, and not being able to relate the material. The CS group said low self-confidence, vocabulary, small attention span, difficult time understanding directions, procrastination, perfectionism, not writing something down, attitude, irrelevance, and no purpose for the assignment. The AR group said time, stress, things that interest me, a large amount of reading, boredom, irrelevant or boring material, too much information presented at one time, and fear.
- Reflective thinking means watching yourself as you learn something and observing what you do, how you do it, and how you feel about it as you do it. Reflect back on one of your learning sessions in this class and describe what techniques or patterns of behavior you might be using to learn. Were you guessing? Were you asking for help? If you did not ask for help, why not? Were you using trial and error? Were you embarrassed? Lost? Frustrated? Excited? Satisfied? Did you gain energy or were you worn out? Did you keep bashing your head against the wall? Were you flexible or rigid? Did you learn better with others or by yourself? (This last question was from Algonquin College of Applied Arts and Technology, 1996)

The AS group did not mind asking for help from others and liked working in groups although they were hesitant at first; they used trial and error much of the time; they were worn out by the end of the class time. The CR group was flexible in their learning and would guess much of the time; they found it hard and tedious to follow the step-by-step instructions of the activities; they like to figure things out in their own creative way; they were energized by the learning and the class work. The CS group concentrated on the steps and "getting it right"; they were anxious and rigid as they completed their activities; they wanted more organization and direction on the student-choice projects; they did not mind asking question after question because it kept them from becoming completely frustrated; they also wanted as much material and information as they could get before attempting any of the activities. The AR group liked to practice things on their own and try to figure things out for themselves and explore their other options; they were flexible and even changed ideas and strategies in the middle of a lesson; they were motivated to do more and felt energized by the work; and they were frustrated by others always asking them questions.

Conclusion

In answering the first question, "How could I formalize this process of action, reflection, and feedback?", the use of the midterm as this assignment provided the answer. The students were motivated to give thoughtful answers in order to receive full credit and they were able to analyze their own

feelings more accurately and use them in a more positive way. They found that they were not alone in their experiences and feelings and that the experiences were a normal and acceptable part of the learning process.

In future classes the reflection will be a weekly activity so that it is not an overwhelming exercise and the students can profit from these reflections. Also the teacher will spend more time with small groups each class period so that students feel like they are getting as much help and encouragement as they need.

In answering the second question, "Do certain types of learners do better with certain types of activities and certain structures for activities?", there were similarities found within each of the four learning style groups. The students were anxious to see the results of the two surveys and to get feedback on what the results meant. They liked doing the self-study and finding out more about themselves as learners. This information helped them as they approached the new experiences in subsequent classes. These surveys also helped them to see that they were not alone and that some experiences would be more positive than others would, and that it was all right to have particular preferences.

In future classes these surveys will be done immediately so that the students can use them as a learning experience and a foundation for the whole class. This experience will make them better, more thoughtful practitioners in their professional lives and will allow them to see things through the eye of the learner. It should also help them evaluate their experiences more thoroughly and grow as lifelong learners.

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Learning About Learning in an Introductory Educational Computing Course

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Current trends in education reflect a shift from traditional didactic pedagogy toward student-centered constructivist instructional practices. These trends are evident in increased attention to constructivist learning theory and teaching methods in preservice teacher education courses (Howey, 1996), and in recent curricular reform reports (National Association for Secondary School Principals, 1995; National Council of Teachers of Mathematics, 1991; National Research Council, 1995; National Science Teachers Association, 1990). Although preservice teachers have been exposed to constructivist theory in their coursework, teachers rarely draw on the learning theories they have studied to guide their practice (Pinegar & Carter, 1990).

Teachers tend to base their pedagogy on their experiences as learners in didactic K-12 classrooms (Knowles & Holt-Reynolds, 1991, Lortie, 1975), rather than relying on formal theories of learning. They often interpret constructivist reforms in light of their previous school experiences and implement constructivist practices in idiosyncratic ways. For example, a constructivist use of manipulatives might entail allowing students to use hands-on materials to develop a concrete representation of an abstract mathematical concept. This process helps students construct more complex understandings and their own problem solutions. However, some teachers integrate manipulatives with their didactic practice by demonstrating the correct way for students to use the materials to solve a problem. Thus, teachers can transform constructivist uses of manipulatives to fit with their existing practice.

Helping teachers change their pedagogy to reflect a more constructivist orientation is a difficult and challenging process. Educational psychology-based courses on learning often present models of learning as complex and abstract theories that are divorced from preservice teachers' personal learning experiences. On the other hand, methods courses typically focus on constructivist instructional strategies (i.e. cooperative learning, reciprocal teaching, discovery learning), helping preservice teachers understand *how* to teach in constructivist ways, but without providing explicit links to the theory-based assumptions that underlie constructivist practice. Preservice teachers need to experience constructivist learning activities from a student perspective if they are to be effective constructivist teachers (Stofflett & Stoddart, 1994). Helping preservice teachers reflect on their experiences as a constructivist learner can help them make important connections between learning theory and related instructional practices.

Most stand-alone technology courses focus on helping preservice teachers learn to use various hardware and software applications (i.e. Downs, 1992; McKenzie, 1994; Niess, 1991; Raiford & Braulick, 1995), and current standards focus on ensuring preservice teachers develop specific technology competencies (Wiebe & Taylor, 1997). Although developing technology related skills is an important goal for teacher education programs, the preservice technology course can also provide a unique context for future teachers to explore their own learning. Unlike methods courses, in which preservice teachers often know the content and focus on learning to teach it, preservice teachers expect to learn new concepts and skills in the technology course. Many preservice teachers enter the class with word processing experience, but little exposure to other productivity applications (Sheffield, 1996). They often have minimal experience with e-mail or Internet browsers and it is rare to find a preservice teacher who has considered instructional uses of technology beyond drill-and-practice activities. Thus, most preservice teachers bring limited skills and understandings needed to integrate technology with their instruction. The technology course provides a forum for them to develop technological competency as they reflect on their own learning processes, develop a deeper understanding of learning theory, examine the relationship between theory and practice, critique the nature of school-based learning experiences, and analyze assumptions underlying instructional methods.

To accomplish these goals, two instructional activities were designed to provide preservice teachers with a common learning experience that exemplified contrasting

approaches to instruction. One activity was a highly structured, teacher directed lesson based on a didactic instructional model. The second activity required preservice teachers to assume primary responsibility for planning and implementing the project as they worked cooperatively to support each other as a community of learners. This activity was based on a constructivist instructional model. Preservice teachers completed these activities during the first quarter of the class and used them as a referent for understanding the discussions and activities that followed.

Didactic Activity

The initial computer activity involved developing a home page using HyperText Markup Language (HTML). Preservice teachers completed the activity by working individually at a computer with little peer interaction. The activity was highly structured as preservice teachers were given a handout that included all of the information they would need to complete the project. The handout provided precise directions that stated exactly what needed to be typed into the text editor (in boldface type), and a detailed explanation of what each line of the program did. Many preservice teachers quickly realized that they could simply type in the boldface lines without reading the detailed explanations and complete the assignment. Their focus was on completing the task rather than developing an understanding of what they were doing. The instructor moved around the lab encouraging the preservice teachers to follow directions exactly, praising their efforts, pointing out typos, and providing technical assistance when necessary. Before long, completed home pages began to appear on monitors. Following the directions exactly provided preservice teachers with identical projects—if they had typed the information correctly, they got it *right*. The underlying assumption was that since they have produced the correct product, they had learned the important concepts through the process.

A brief multiple-choice test was administered at the beginning of the next class period as a traditional assessment of what had been learned. Test items were taken directly from the detailed explanations on the worksheet (which few students had even read). A review of the right answers followed with considerable praise as a reinforcer for those who had managed to choose correct responses. At this point, a fairly large group of preservice teachers felt frustrated and angry. They had accomplished the task and produced an acceptable product, but the quiz forced them to reflect on how little they had learned. Interestingly, preservice teachers criticized the nature of the instruction and their perception of what the instructor should have done, and refused to accept responsibility for their own learning.

The class discussion that followed focused on tying the activity to behavioral learning theory—expert designed outcomes, focus on product, detailed sequential instructions, ongoing praise and feedback, and tests of factual information in which the teacher determines what is important and what counts as a right answer. The instructors explained how didactic instructional principals had been used to design, teach and evaluate the lesson, and many preservice teachers acknowledged that this activity was fairly representative of their previous school-based learning experiences. The heart of the discussion, however, centered on learning.

Preservice teachers felt satisfaction from completing the home page but questioned whether they had learned anything meaningful from the activity. Some preservice teachers had experience with HTML and did not believe the activity had added to their knowledge. Others had no experience with HTML and, although they had produced a home page, did not believe they had learned the skills and understandings necessary to independently create a home page, much less teach their future students to do it. Most preservice teachers confessed to having adopted a "get it done" strategy with little concern for developing an understanding of the HTML code. They were unwilling to spend time outside of class to work on the assignment, nor had they reviewed the handout to try and make sense of what they had done. All admitted that, although the activity was fun, and seeing the finished product was rewarding, they had not really learned much that would be useful in the long term.

Further discussion addressed the appropriateness of the activity for the desired outcomes. If the goal for the activity was to help preservice teachers develop an understanding of how to develop a homepage using HTML, the instructional method was inappropriate and preservice teachers' approaches to learning were ineffective. However, our goal as instructors for the course was met. Preservice teachers were forced to critically examine both the fairly traditional instructional methods used for the lesson and their role as a learner.

Constructivist Activity

The second activity involved creating a home page through a more active constructivist approach. The assignment involved developing a home page around an academic theme. Preservice teachers had a good deal of flexibility in planning and implementing the project. They learned to search the web for relevant information and sites, read source code from other pages to get ideas for features for their own page, and learn from and teach each other. Preservice teachers were encouraged to be creative, to share their work and expertise with their classmates, and provide suggestions and help for each other. The assignment helped the group develop into a community of learners and they continued to help and support each other through the remainder of the course. The activity was spread over several weeks so that students would have ample time to develop deep and connected understandings of the process.

The preservice teachers initially experienced a good deal of frustration and anxiety working on the project. As the project progressed, they recognized the considerable time and effort needed to engage in meaningful learning. The instructor was available as a resource, guiding preservice teachers in potentially fruitful directions and asking questions to challenge thinking rather than providing information and giving directions.

A group evaluation session allowed each preservice teacher to present their work, explain some of the features they had incorporated, and address questions from their peers. Preservice teachers shared their ideas, criticisms, and suggestions freely. All participants benefited from the information shared during the formative evaluation session. In the ensuing discussion, the class explored the components of a constructivist learning orientation that were apparent in this activity—student agency in designing the activity; actively seeking, organizing, and producing knowledge, cooperation with peers, and holistic evaluation of the project.

Preservice teachers stated that the project had been an excellent learning experience, although it had been extremely time consuming and frustrating. They reported that the project took on personal significance as they worked through their difficulties and many went beyond what was required because of their high level of interest and engagement. The discussion was structured to encourage preservice teachers to reflect on the nature of meaningful learning, roles of the learner, and roles of the teacher. Taken together, the didactic and constructivist learning activities provided an experiential referent that the preservice teachers could draw on as they considered the role of educational technology in the learning process.

Building on the Foundation

These learning activities met several of the course goals. First, class discussions prompted reflection. The preservice teachers were encouraged to think about the strategies they employed to complete the activities, how their motivation and goals differed relative to the projects, and the differences in their levels of understanding of HTML relative to the two activities. The activities also provided a common experience-based referent for reflecting on two important theoretical orientations toward learning—behaviorism and cognitive constructivism. Readings and class discussions about learning theory that occurred concurrently with the activities were greatly enhanced because preservice teachers were able to relate the theory to their own personal learning experiences. These experiences enabled them to examine the relationship between the assumptions underlying the theory and the instructional methods used in the class. Other course activities built on this foundation.

Software Evaluation

Software evaluation focused on the underlying theoretical assumptions about learning that guided its design (e.g., behavioral principles in drill-and-practice and tutorial software, and constructivist components in programs like SimLife and the Geometer's Sketchpad). Class discussion of software evaluation focused on how the same piece of software could be used to support more traditional didactic instruction (e.g., teacher PowerPoint presentations) or a more constructivist orientation (e.g., student PowerPoint presentations). Potential learning objectives were examined relative to how various types of software supported different learning goals (e.g., memorizing, problem solving, exploration, etc.). Thus, preservice teachers used their own learning experiences as a referent for analyzing assumptions about learning inherent in instructional uses of technology.

Field Experience

Preservice teachers were required to conduct observations and interviews with teachers during a two-week field experience. They examined the types of software teachers used, how teachers used the software, and teachers beliefs about the role of technology in education. Learning theory provided a framework for the preservice teachers to critique and understand classroom applications of technology. This activity addressed the goal of helping preservice teachers explore and critique the nature of school-based learning experiences and analyze the assumptions underlying various instructional methods.

Student Outcomes

Student feedback revealed a range of opinions concerning the value of the course. Most students reported increased motivation and a better understanding of material learned through constructivist methods; however, some students failed to see the relevance of connecting theory to practice. Thus, although they claimed to enjoy constructivist learning activities, students questioned the need to understand learning theory. Excerpts from course evaluations reflect their thinking: "[You] might want to back off from all the psychology and philosophy material. I felt we spent too long on this subject. In fact, very long with respect to this being a computer introduction class." And "I do not feel that this course will help me as a teacher in the area of technology. I believe the behaviorist/constructivist [information] could have been taught in the first couple of weeks, then we could have studied more useful things."

Other students; however, embraced the importance of the learning theory component of the class: "This was a great class. It was difficult and challenging which really made me think and examine my own motivations and knowledge." And "The information we learned . . . was useful to me and helped me understand new concepts. I think I understood the differences between behaviorist and constructivist approaches better than in any other classes

where we've talked about these things." Learner variables, such as whether preservice teachers were willing and able to be active learners and reflect on their own learning processes, influenced what students gained from the course activities. Making connections between the readings and discussions about learning theory, their personal learning experiences, and the instructional practices they observed required effort on the part of the student.

Conclusion

The actual activities (learning to write HTML code) is not critical to the value of the course. We chose this topic because it was unfamiliar to most of our students. Any novel and complex learning activity could be framed to contrast the differences between didactic and constructivist instructional methods.

Preservice teachers developed increased confidence and competence in their ability to use computers by the end of the course. Skills were learned in a highly motivating "project-based learning" context (see Blumenfeld, Soloway, Marx, Krajcik, Guzdial & Palincsar, 1991), in which students take responsibility for determining what they need to know and how to go about learning it. Support was available, including peers, instructors, and lab technicians, and students decided how to best use these resources. Students had developed many skills for using technology as they completed the course. They had also learned strategies for getting new skills when they were needed.

However, students in the course learned more than just competencies for using computers in the classroom. The learning theory backbone of the class enables them to make decisions about how different types of computer programs can support different learning goals, how to select software that meets learner needs, and how to evaluate new educational technologies from a student learning perspective. The connections they make between learning theories, their own learning, and educational technology provide a solid experiential base that will serve them well in the teaching profession. Students developed a theoretical orientation to learning that guides decision making about how to use technology in their instruction, rather than specific ways to use computers that will soon become outdated.

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INSTRUCTIONAL STRATEGIES FOR INTEGRATING TECHNOLOGY: ELECTRONIC JOURNALS AND TECHNOLOGY PORTFOLIOS AS FACILITATORS FOR SELF-EFFICACY AND REFLECTION IN PRESERVICE TEACHERS

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For most undergraduate teacher education students, technology skills begin and end at the basic survival skills of paper writing using a word processor and, perhaps, sending e-mail. Frequently, these students approach a required technology course feeling some fear or anxiety related to the more sophisticated use of computers. They often perceive themselves as novice technology users, discounting their own level of experience with word processing software and e-mail as a useful foundation for further skill development. Factors contributing to this are the preservice teachers' insufficient experience with computers, their lack of understanding of how interactive technologies can easily be integrated into the curriculum, and little confidence in their abilities to acquire computer instruction (Hunt and Bohlin, 1991; Zelman, 1986). In addition, the enormous marketing hype that surrounds technology suggests that anyone less than a power-user is hopelessly unhip, a sensitive claim for most undergraduate students (Kovalchick, 1997).

When students have no training or experience and have no confidence, reluctance to use technology is rooted in computer anxiety or "computerphobia" (Kennewell, 1992). Many preservice teachers are not so much afraid of the machines themselves, as of their own ignorance and lack of understanding. Electronic journals (e-journals) offer students an outlet to share their fears, hopes, and expectations with the instructor about their learning experiences. They also allow the student to communicate with the instructor how they are understanding the content, sequence, and even presentation of the material. Technology portfolios provide students the opportunity to demonstrate their accomplishment and to reflect upon their learning over the course of a semester. This paper describes the use of e-journals and technology portfolios as an instructional strategy in preservice teacher education technology courses.

Description of the Course

Introduction to Media and Computers in Teaching, EDLF 345, is an introductory level, two credit, preservice teacher education course offered every fall at the Curry School of Education at the University of Virginia. The majority of the students are preservice teacher education students—in their third year of college—who are interested in teaching at the elementary, middle, or high school level. A minority are in the Masters of Teaching program; and a few are non-education students. All preservice teacher education students are required to take the course. Those more technologically advanced can substitute a three credit technology course also offered in the Curry School.

E-journals

Journals, widely used as an instructional strategy in the language arts and other subject areas at the K-12 level, are finding their way into teacher education as a way to facilitate the development of reflective thinking. A journal, or learning log, is a compilation of students' reflections, learning, and feelings about a certain subject or topic. They can be used in a number of ways: for example, teachers can ask students to write in an open-ended manner about the content they have learned, questions they still have, and how the content relates to their own experience. Or, teachers can provide students with prompts for them to write about in their journals.

Journals can provide teachers with a way to assess and monitor student development throughout the learning process, which is not possible through standardized tests or other one time measures. Because they require students to synthesize and reformulate what they have learned, journals and their word processor equivalents, e-journals, serve to

foster students' higher order thinking. An e-journal is basically the same as a paper and pencil journal, but it is composed using a computer and software program.

Using E-Journals with Preservice Teacher Education Students

In EDLF 345 the instructors have begun using e-journals as a way to examine the students' learning throughout the semester and to model a strategy they can later utilize in their own classrooms. After each class, students create an entry in their e-journals using a word processing program. They are encouraged to write about whatever they like related to the class. The following questions provide some guidance for those who do not know what to write about:

- What did you learn today?
- How do you feel about using technology?
- What was the most useful/meaningful thing you learned in today's class?
- How could you apply the content of today's class in your personal, academic, or future professional life?
- What did you contribute to today's class?
- What could the instructors do to improve today's lesson/the course?
- What are some of your questions or concerns regarding the class?

Each entry is dated and saved in the same file. They are sent to the instructors via e-mail as an attachment three times during the semester. The journals are intended to provide students a map of where they have been and underline the evolutionary process of their learning as it unfolds. They begin to see that learning is sometimes messy, frustrating, and often announces itself in short spectacular "ahas!."

E-Journal Entries

Fall 1997 (E-journal entry)

I was a bit intimidated before making my newsletter and had no idea that I could do as much of it on my own as what I did. I have little experience with computers and the class lesson that day went a little fast for me, I wasn't quite able to keep up. Thanks for listening.

In many technology classes, students are reluctant to ask questions during class because they are embarrassed or feel that they are the only ones experiencing such problems. E-journals provide a safe way to ask questions, converse with, and offer suggestions to instructors about the class.

A preliminary analysis of student e-journals reveals a pattern in the types of responses included. Their responses generally fall into two categories, "making connections within the classroom" and "making connections outside the classroom." Below is a table outlining the types of entries in each of these categories.

The following e-journal entries illustrates the different categories described above:

Example 1

This seems to be an appropriate time in the semester to reflect and discuss how I feel about using technology. At the beginning of this course I was absolutely petrified of having to take a computer class. I feel comfortable with a word processor, and that is about the extent of my computer background. I was one of these people who think that I will be able to skim by without ever having to use a computer other than having to type a report. I am beginning to realize that this is highly unlikely, especially while hoping to enter the field of teaching. I now realize that I need to be up to date with the needs and concerns of students in a rapidly

Table 1.
E-journal response patterns.

Making Connections within the Classroom:	Making Connections outside the Classroom:
Reflective student: These entries are typically written in diary format; they recount what was learned in class and how the student feels about using technology.	Reflective teacher: Students relate how they plan on using technology in their future classrooms as professional technology-using teachers.
Dialogue with the instructor: Students ask the instructor questions or comment on any aspect of the class (including constructive critiques of how the material was presented).	Other experiences with technology: These responses generally describe students' experiences with technology in different environments, for example, their employment and other classes.

increasing technological world. It is probably not good for a teacher not to have any idea in instructing a student in how to operate different computer programs. I can only imagine how ugly a newsletter would be if I used only a word processor to create it.

Example 2

Fortunately I am not nearly as intimidated by the uses of technology now as I was in the beginning. When I imagined what the instructors of this class would be like I was scared I would get instructors who were unable to deal with people, only computers... I feel very comfortable with both of my instructors and am confident that if I don't understand something in class, I can get the help needed after class... To say the least my level of anxiety has been significantly reduced since the beginning of the semester.

Early feedback from the introduction of e-journals during the Fall, 1997 semester of EDLF 345 has been highly encouraging. E-journals are providing opportunities for reflection and a means to link what students are learning in the classroom with their future roles as technology-using teachers. They are also allowing students to converse with the instructors and share their meaning-making. Using e-journals as an instructional strategy also benefits the instructor. They help the instructor understand the student better as well as help him/her gauge and modify the class, which can have an impact on current and future students' needs. In addition, students themselves are more capable of understanding the technological world around them, and how they plan to deal with it.

Technology Portfolios

Whereas e-journals demonstrate learning in its developmental phases, portfolios represent the culmination of a student's work over a period of time, for instance, a semester. Many definitions exist in the literature regarding portfolios and the types of portfolios that exist. In general, a portfolio is a compilation and reflection of students' work, efforts, and progress. The different kinds of portfolios are showcase, descriptive, evaluative, and composite portfolios (Halaydna, 1997; Shackelford 1997). Each of these has unique objectives and methods for assessment. Shackelford (1997) suggests that "As instructional strategies, they promote the application of knowledge, self-assessment, and the development of individual talents, skills, and values" (p. 31). Furthermore, Russell and Butcher (1997) assert:

As a perspective over time during a course or curriculum, portfolios pull together a lot of information and artifacts. These materials lend themselves to formative evaluation and revision. Portfolios have the added advantages of allowing students to organize their knowledge, skills, and materials, to develop an in-depth understanding of the content, and to show peers and professionals what they have learned and can do.

A technology portfolio is similar to a traditional portfolio, but it specifically addresses technology skills and issues. Also, the medium is different since it is organized using a combination of electronic media such as hypermedia programs, database, spreadsheet, and word processing software, as well as CD-ROMs and the World Wide Web. Technology portfolios can be print-based, saved on a computer disk, compiled on a CD-ROM or HomePage, or a combination of the above. How it is published depends on the resources available in addition to the teacher's objectives. Tuttle (1997) contends that digital portfolios should be used because they demonstrate wider dimensions of learning, their parts can be interconnected, and they save space.

Levin (1996) explains that technology portfolios can be used to meet ISTE/NCATE guidelines. One challenge to meeting these guidelines is that cheaper, easier to use multiple choice tests do not accurately measure students' competence in technology. Technology portfolios are the answer to the dilemma as they serve as performance-based measures. Performance-based assessment has become increasingly accepted in education, especially by some major teacher education organizations, for instance, the Interstate New Teacher and Support Consortium (INTASC).

The items in a technology portfolio will depend on the context of the technology training, the resources available, and the amount of time (e.g., stand alone semester course or methods class that integrates technology). Levin (1991) and Petrakis (1996) describe the components for technology portfolios—specific to their objectives—which they have used with preservice teacher education students. The following items can be included:

1. Educational technology philosophy statement (Why technology is important for instructional purposes.)
2. Hands-on competencies/projects completed in the course
3. Weekly E-journal entries
4. Samples of work created outside of the requirements of the course
5. Self-evaluation of the items included in the portfolio

In EDLF 345, students collect examples of their work over the course of the semester for inclusion in their technology portfolios. These portfolios are intended to allow students to make a personal statement, which reflects their growth, change, and competence in the use of technology. As such, the keystone of the Technology Portfolio is a self-evaluation. Students are asked to provide an analysis of each piece of work that they choose to include in their technology portfolio. This self-evaluation must address three issues:

1. Students must comment on the quality of the work
2. Students must provide a rationale for each item's inclusion in the portfolio
3. Students must describe how - as a teacher - they might use the technology represented by the work toward an instructional goal

Students are encouraged to consider a broad definition of how success can be demonstrated. In this way, technology portfolios function as an instructional strategy that emphasizes problem-solving and the development of a conceptual understanding of software applications rather than simply the performance of various keystrokes, commands and menu selections. Instead, they are encouraged to consider patterns in the design of interface metaphors that serve or hinder user-friendliness and to critically evaluate much of the "hype" that surrounds technology promotion. Training preservice teachers to use technology requires that they be prepared to advocate for technology that supports their instructional goals and those of their students. It's likely that they will need to function as change agents in a system constantly under pressure to reform. For this reason technology use is not presented as merely a series of technical competencies, but also as having psychological, social, and economic aspects.

Self-efficacy and a reflexive approach

As defined by Bandura (1993), self-efficacy relates to an individual's perceptions about his or her own ability to perform a specific function. As such, it is a good predictor of behavior. People with low self-efficacy tend to shy away from those situations where they feel they have little control or ability to handle a task. Consequently, those with low self-efficacy toward technological innovation are likely to feel high levels of anxiety, and as a result, resist learning to use computers. Those same feelings of inadequacy about technology regulate the degree of commitment and perseverance an individual is willing to put forth to the learning situation (Olivier & Shapiro, 1993). Mager (1992) suggests that performance mastery is the principal way to help build self efficacy. Technology portfolios offer a means to document performance mastery as a personally relevant process, and e-journals help students reflect about the whole process.

The role of reflexive thought in preservice technology training is central to students' growth beyond a basic level of skill and operational facility in using technology and media for education. The use of technology portfolios and e-journals places an explicit focus on the relationship between technology applications and instructional methods. This reflexive approach to technology training encourages students to consider technology as both a user/learner and a user/teacher. In this way, students articulate their awareness of the effectiveness of instructional methods supported by technology and can develop skills to become thoughtful decision-makers regarding its uses. For example, by fostering opportunities for metacognitive development, a reflexive approach helps students gain accurate perceptions of how their behaviors may support or impede learning, as one student concluded in his portfolio:

Fall 1996 (Portfolio self-evaluation)

On September 3, 1996 I began a class on computer technology that I was sure would be a waste of my time. There was nothing I could learn that would enhance my teaching ability; I was positive. I guess it just goes to show that I shouldn't listen to my pride. We can all learn from the knowledge of others, so I have dedicated my portfolio a "Portfolio of learning" because this semester I learned that I am never too old to learn something that will benefit my students, and I should never let pride or fear of weakness stand in my way.

Specific competencies, such as those that require students to evaluate software, CD ROM's and websites can also nurture self-confidence and self-reflexive awareness. Focusing student attention on evaluation processes helps them to realize that as users rather than as programmers or technical specialists, they possess sufficient knowledge to judge technology's instructional utility.

Conclusion

Too often novice technology users discount their own level of experience with word processing software as a useful foundation for further skill development. E-journals and portfolios shift the emphasis from one of achievement to one of effort. They help to make students' technology training a sense-making process that is constructed at their own pace and is driven by their individual needs and interests. As one student wrote in her Technology Portfolio:

Fall 1996 (Portfolio self-evaluation)

I was very nervous about this class when I first registered for it. The only computer skill I possessed was word processing, and I had previously been frustrated with computers when I did not know how to operate them. I looked forward to learning about computers so that I could put aside some of my frustrations, yet I was worried that I would not be able to understand the material. Now I feel quite comfortable with computers. I may not be able to answer all the questions about computers or do some applications really fast, but I have enough knowledge about computers that I could probably figure out most problems.

A reflexive approach to technology training may employ performance-based approaches, such as the weekly skill-based competencies. However, a reflexive approach is constructivist in design as well because students actively participate in making their own meaning. Technology portfolios support students' learning by requiring them to make deliberate choices about what to include in their portfolios and to link their present skill level to a skill level at an earlier point in time. Technology training can be a thoughtful experience when it encourages students to comment on their learning through the use of e-journals and technology portfolios, to work collaboratively in both learner and instructor roles, and to critique technology's educational function. Finally, e-journals and technology portfolios

can be used as a means of meeting and demonstrating ISTE/NCATE guidelines as well as many states' licensure requirements for teachers.

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Anchored Instruction in Preservice Educational Technology Classes: A Research Project

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Many professional teacher education programs require students to take courses that prepare them to integrate the use of various technologies in their daily teaching activities. One approach to the design of such courses involves using a theme or anchor around which various learning activities take place. This approach has been referred to as "anchored instruction" (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990).

While researchers have claimed that anchored instruction is an effective approach in preparing preservice teachers to integrate technology (Bauer, Ellefsen & Hall, 1994; Bauer & Summerville, 1996), very little empirical data exist to support these claims. In this study, the researcher designed, tested, and employed an instrument in order to answer the following research questions:

After participating in a preservice educational technology course based on principles of anchored instruction:

1. will students feel that they learned basic technology skills?
2. will students understand why the instructor used an anchored instruction approach?
3. will students feel that they can apply anchored instruction as a technique for technology integration in their own teaching?
4. will students have enjoyed participating in the class?

Forty-eight students enrolled in three sections of a one-semester-hour preservice educational technology class during the summer, 1997, participated in this study. Table 1 summarizes the characteristics of the subjects involved in the study.

Limitations of the Study

The reader is cautioned that there are three limitations to this study that may threaten its generalizability. First, the researcher also acted as the instructor for these preservice educational technology classes. This individual has had nearly twenty years of classroom experience and has won awards for excellence in teaching. It is possible that other approaches could have yielded similar results in terms of student satisfaction.

Second, this study utilized intact groups with a single treatment-posttest design. No control group was used, and there were no attempts to randomly select subjects for this study.

Finally, at the time of the writing of this article, internal reliability statistics have not been calculated for the instrument used. Also, a significant amount of qualitative data including field notes and open-ended responses designed to triangulate the Likert questionnaire was collected. Analysis of this data is ongoing.

Using MECC's Oregon Trail as an Anchor

The instructor began by explaining the basic concepts of anchored instruction to the class, and then employed the principles of anchored instruction in teaching the class for its entire six-week duration. During the last session, students were given a fifteen-item questionnaire that focused on the four research questions mentioned previously.

Oregon Trail, MECC's popular computer simulation program, was selected as the anchor for the course. This program fit the requirements of a good anchor by providing a rich learning environment upon which many learning activities could be built (McLarty, Goodman, Risko, Kinzer, Vye, Rowe, & Carson, 1990). All of the activities involved the integration of appropriate technologies, including word processing, spreadsheets, presentation software, drawing and painting programs, hypermedia, Worldwide Web exploration, and audio/video processing.

The researcher borrowed five key decision points for using anchored instruction from McLarty et al., (1990) and added one additional item. They were as follows:

- Choosing an appropriate anchor (McLarty et al., 1990)
- Developing shared expertise around the anchor (McLarty et. al., 1990)
- Expanding the anchor (McLarty et al., 1990)
- Teaching with the anchor (McLarty et al., 1990)
- Allowing student exploration (McLarty et al., 1990)
- Sharing what was learned from the anchored instruction (Bauer, Ellefsen & Hall, 1994)

Figure 1. Oregon Trail II Simulation Software.

Students first explored MECC's *Oregon Trail* simulation program in order to develop a shared expertise around the anchor. They collected data as they ran through the simulation and organized it using a spreadsheet program. The resulting product looked like the sample shown in Figure 2.

This activity accomplished at least two objectives. First, students learned how to collect and organize data electronically. Second, students learned basic spreadsheet operations such as data entry and creating formulas to automatically calculate values (miles traveled between landmarks, miles traveled per day, etc.). Students then formulated and tested hypotheses based on the data that they collected. For example, they hypothesized that the number of miles traveled per day would decrease as the wagon train crossed the mountainous regions of Wyoming, and that travel would be slower during rainy or snowy months than it would be during dry months. Again, students used the data that they collected to affirm or contradict their hypotheses.

Another type of data that is easily accessible is the trail log or diary (depending on which version of the *Oregon Trail* software is used). Both the trail log and the diary keep track of daily events during the simulation. Students exported these files to a word processor and used them as a basis for a creative writing activity where they wrote fictional letters home from the trail. Students were encouraged to embellish the details of their vicarious adventures along the Oregon Trail.

The next activity involved exploring the Worldwide Web to see what information students could find related to the Oregon Trail. This activity was designed to follow McClarty et al.'s third and fifth key decision points—expanding the anchor and allowing student exploration. Students were organized into small groups. Each group selected a site along the Oregon Trail to explore. Several excellent Worldwide Web sites were identified including the following:

- http://pbs.org/opb/oregontrail (This website includes sections on facts, myths, and trivia along with a teacher's guide for using the PBS video series)
- http://www.nationalparks.org/guide/parks/fort-laramie-1986.htm (National Park Foundation's Fort Laramie site)
- http://www.teleport.com/~eotic/stories ("The Road to Oregon: Articles About the Oregon Trail")
- http://www.isu.edu/~trinmich/facts.html (Idaho State University's "Fantastic Facts About the Oregon Trail')
- http://www.ukans.edu/kansas/seneca/oregon/mainpage.html (University of Kansas' "Oregon Trail: The Trail West")
- http://www.ohwy.com/or/o/oregontr.htm (Oregon Online Highways)
- http://www.mecc.com/ies/oto/oto.html (MECC's online version of the Oregon Trail computer simulation)

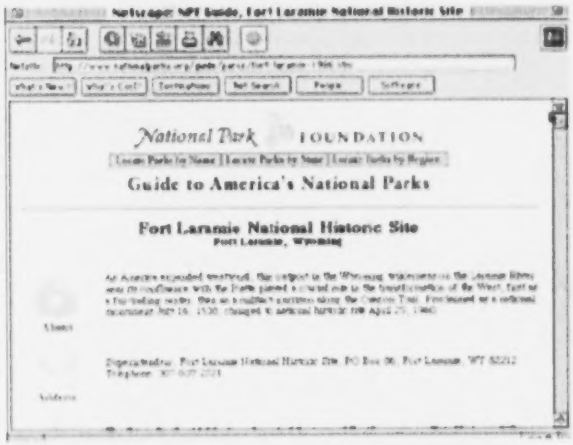

Figure 3. National Park Foundation's Fort Laramie Worldwide Web Site.

Once the information was gathered and processed, Powerpoint presentations were developed. These presentations included scanned pictures, images downloaded from the Worldwide Web, Quicktime movies, and text. Students used a computer projector to share their projects.

Students expanded the anchor even further by developing individual Oregon Trail Hyperstudio stacks related to their areas of interest or academic major. One earth sciences student, for example, developed a stack that explored various geomorphic features along the trail. A music major developed a stack that explored composers of the 1840's.

Anchored Instruction Questionnaire: Summary of the Data

At the conclusion of the course, students completed a fifteen-item Likert questionnaire in order to answer the research questions. There were between three and five items

Table 1.
Demographic Characteristics of Participants.

Majors		Ages	Rank		Grade Level Preferred		Gender	
Biology	2	Median	Freshman	0	Preschool	1	Male	12
Business	1	=23	Sophomore	7	K-2	18	Female	34
Earth Sciences	1		Junior	20	3rd - 5th	16	Not reported	2
Education	2	Mean	Senior	10	6th -8th	7		
English	10	= 23	Graduate	9	9th - 12th	18		
History	1		Not reported	2	Other	1		
International Studies	1	Range			N/A	1		
Math	2	19-44						
Music Education	1				(some students			
Physical Education	1	Mode			listed more			
Social Sciences	9	= 20			than one			
Sociology	1				preference)			
Spanish	1							
Special Education	7							
Speech Communications	5							
Theater	1							
Not reported	2							
Total	48			48				48

Date	Landmark	Total # miles	Pace	# People	Miles/ landmark	Days	Miles/Day
4/1/48	Independence	0	Steady	5	0	0	0
4/8	Kansas R.	102	Steady	5	102	7	14.6
4/13	Big Blue R.	185	Stren.	2	83	5	16.6

Figure 2. Sample of Oregon Trail Spreadsheet Activity.

for each of the four research questions. The data summarized below include (a) the research questions, (b) the individual items from the questionnaire related to each research question (not in the same order in which they appeared on the original questionnaire), and (c) tables containing percentage data for each item from the questionnaire.

Research Question 1. Will students feel that they learned basic technology skills?

Item 1. I am satisfied with the amount of information that I learned in this class

Item 2. I learned very little about educational technology in this class.

Item 3. I learned alot about educational technology in this class.

Item 4. The projects in this class were a waste of time.

Research Question 2. Will students understand why the instructor used an anchored instruction approach?

Item 5. I understand why the instructor used the Oregon Trail simulation as a theme or anchor for this class.

Item 6. I have no idea what anchored instruction is.

Item 7. The instructor should continue to use anchored instruction as a basis for teaching this class.

Research Question 3. Will students feel that they can apply Anchored instruction as a technique for technology integration in their own teaching?

Item 8. Using the Oregon Trail simulation as the anchor in this class helped me understand how to integrate technology into my own teaching.

Item 9. I understand how I can use Anchored instruction in my own teaching.

Item 10. Using the Oregon Trail simulation as the anchor in this class confused me about how to integrate technology into my own teaching.

Research Question 4. Will students enjoy participating in the class?

Item 11. I looked forward to coming to this class.

Item 12. I dreaded coming to this class.

Item 13. I enjoyed using the Oregon Trail simulation as a basis for the projects in this class.

Item 14. I would have preferred another approach - rather than anchored instruction - in this class.

Item 15. Using the Oregon Trail simulation as a basis for the projects in this class was a bad idea.

Table 2.
Data Summary for Item 1.

	SA	A	N	D	SD
Item 1	56%	33%	2%	6%	2%
Item 2	0	2	2	27	69
Item 3	60	35	2	2	0
Item 4	0	0	2	35	63
Item 5	77	21	2	0	0
Item 6	0	4	6	19	71
Item 7	73	17	10	0	0
Item 8	65	33	0	2	0
Item 9	58	35	4	2	0
Item 10	0	0	4	31	65
Item 11	50	33	15	2	0
Item 12	0	0	6	25	69
Item 13	54	44	2	0	0
Item 14	0	4	6	42	48
Item 15	0	0	2	23	75

SA = Strongly Agree; A = Agree; N = Neutral; D = Disagree, SD = Strongly Disagree. All numbers in tables are percentages. N = 48

Discussion and Conclusions

The data indicate that the anchored instruction approach worked well for the preservice educational technology course. Students reported:

- they did learn technology skills that they could use in their teaching;
- they understood why the instructor used anchored instruction;
- they could apply the approach in order to integrate technology into their own teaching; and
- they enjoyed participating in the class.

Technology integration is an important skill for preservice teachers to develop if they are to be innovative and successful professional educators. It is a topic that is discussed in most preservice educational technology courses and in textbooks. Rarely, however, do instructors model technology integration using techniques that preservice teachers can easiiy apply in their own teaching. Anchored instruction is one model that can be used to show preservice teachers how to integrate appropriate technologies in their teaching regardless of the grade level or content area. The data presented in this study clearly indicate that students responded positively to this approach and learned essential technology skills in the process. There are, perhaps, other models and approaches that my be as effective in preparing the current generation of teacher candidates. Individuals in charge of preservice teacher technology preparation should actively seek out these models and approaches and conduct further research to determine their effectiveness.

For an update to this article, plus other information related to anchored instruction in preservice educational technology courses, check the following URL: http://

www.edtech.unco.edu/Professors/BauerWebsite/Bauer.HTM

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Teaching 'How to' Technologies in Context

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Iowa State University

Many educators contend that learners learn best when they are active and engaged in activities that are linked to real-life experiences (Bednar, Cunningham, Duffy & Perry, 1992). The concept of having new learning related to personal experiences or prior knowledge is key to situated learning theory and also central to the constructivist paradigm (Fosnot, 1992). Such activities are thought to be both motivating, causing the learner to better attend, and a trigger to prior knowledge. Situated learning is concerned with the learning activities as well as the learning environment. In clarifying the challenges, Harley (1993) states, "for the classroom teacher the challenge of situated learning theory becomes one of developing methodologies and course content that support cooperative activity, and reflect the complex interaction between what individuals already know and what they are expected to learn, recognizing that ultimately meaning can only be established *by* and not *for* the learner" (p. 47). The students also face challenges in that "the role of learners within authentic, situated learning activity is one whereby they are encouraged to recognize that they themselves are intentional agents creating their situate experience within a culture of activity, as opposed to being simply external observers or incidental actors" (p. 49).

Reformers, futurists and educational technologists agree that advanced technologies can go far in creating and supporting complex and rich learning environments (e.g., Dede, 1996; Means, 1994; Cognition and Technology Group at Vanderbilt University, 1993). The classroom teacher is thus encouraged to learn the techniques for creating authentic learning environments as well as become familiar with the technologies that support them. In fact, the encouragement to use technology in the classroom in compelling ways has found itself in the formalized guidelines and standards written by the International Society for Technology in Education (ISTE) and the National Council for Accreditation of Teacher Education (NCATE, 1995). Consequently, the faculty in teacher preparation programs are not immune to these challenges. In preparing teachers that will likely create rich learning environments in the classrooms of the future and use technology in meaningful ways, faculty are encouraged to model such practices throughout the preservice curriculum (Thompson, Schmidt and Hadjiyianni ,1995) . In order to use or create technology supported environments or incorporate technologies into daily curricula, classroom teachers need at least a basic knowledge of the operation of the technologies. To meet this need, technology courses in curriculum and instruction departments naturally contain 'how to' components. In introductory undergraduate and graduate level instructional technology courses at Iowa State University, students are taught how to use photography and video technologies as well as computer-based tools. In these beginning courses, the emphasis is on 'how to' operate the technology, although effectively integrating the technology or the technology products created by the students into learning environments is discussed throughout these courses. The problem becomes how to model the use of situated learning in the teaching of these 'how to' technologies. One could possibly use computer simulations to teach the complex nature of certain technologies. Such a strategy was described by Valde, Bower and Thomas (1996) in teaching the workings of the computer memory as students strive to learn computer programming and the basics of how a computer works. However, the instructor of the graduate introductory instructional technology course described in this paper chose to create a situated learning environment using low-technology everyday surroundings to teach the fundamentals of photographic and video production. It should be pointed out that throughout the course, students were encouraged to use the learned techniques to enhance their classrooms or to create video-based learning environments.

The introductory instructional technology course is a survey course covering various technologies. The instructor decided to link the photography, audio, and video laboratory exercises together into a cohesive laboratory project anchored in the campus environment. Small groups of students worked together learning to operate 35mm single lens cameras, video recorders, video presentation equipment (Elmos), video editing stations, video dubbing equipment and audio equipment. In addition, the product from one laboratory exercise fed into subsequent exercises. This idea of connecting the assignments is somewhat different than what is done in survey courses where each laboratory

exercise is independent of another. In such cases where the assignments or exercises are independent, a group's performance on a photography assignment does not influence their performance on the video editing exercise or a final laboratory product. By linking the exercises together, the instructor hoped to more accurately reflect real-life video production. Thus, each student group learned the various steps of video production by performing the laboratory exercises. The instructor specified a video tour of the Iowa State University campus as the final laboratory project thus providing a real-life environment in which the students could relate and have shared experiences.

This paper outlines the organization of the laboratory exercises and relates how learning in context aided student groups that were expected to use the knowledge attained in the laboratory classroom to produce a graded video project outside the laboratory classroom. The graded video project would contain many or all of the components of the laboratory project yet focus on a social issue of their choosing.

Methodology

During one of the first laboratory exercises, the students were instructed in the use of the video presenter (Elmo) machine to transfer prints to video and were given brief demonstrations on the use of the video editing stations and audio equipment. The photography laboratory was the first laboratory involving in-depth exposure to the technologies. Since photography was not in the area of expertise of the instructor, a senior graduate student delivered a twenty-minute session including direct instruction on the parts of the camera, emphasizing the use of aperture and shutter speed settings to achieve equivalent exposures and to alter the depth of field. During this session each student had a single lens camera to handle. Afterwards, the students were asked to form groups to carry out the laboratory assignment.

Photography assignment

The instructor had sketched various buildings or points of interest around the Iowa State Campus. These roughly drawn sketches were then transposed onto laminated storyboard cards created in PowerPoint (Figure 1). An effort was made to include long, medium, and close range shots. The students divided into three groups and each group was given one camera, one roll of 24 exposure color print film, and an exposure recording sheet (Figure 2). The film was loaded into the cameras prior to leaving the classroom. Because one group failed to load the film properly and no extra rolls of film were available, the class was divided into two groups rather than three. The two groups of students were each given six of the twelve storyboards and were instructed to photograph the points of interest sketched on the cards. They were further instructed to allow each member of the group hands-on experience with the camera and to experiment with various exposures (aperture and shutter speed) for each storyboard card. For each film exposure, the students were to record the storyboard card number, aperture, shutter speed and ASA setting.

Storyboard 8
Medium shot of Campanile at angle. Include view of two clocks

Campanile
The bells of the campanile ring out on the quarter hour

Figure 1. Storyboard card

Exposure Number	Storyboard Number	F Stop	Shutter Speed	ASA
21	8	22	500	200
22	8	16	125	200
23	8	5.6	500	200
24	8	1.7	125	200

Figure 2. Excerpt of recording sheet entries

The student groups returned the two rolls of film and the recording sheets to the instructor. They discussed the exercise and pointed out that some of the storyboard shots were impossible to obtain without special lenses. They emphasized the importance of the photographer being given that information or being able to anticipate the need. Once the film was processed, the storyboard cards were displayed along with the corresponding prints of various exposures and small graphics depicting the aperture and shutter speed settings that were indicated on the recording sheets (all exposures used the same ASA settings). The students examined the prints and commented on the effects that aperture and shutter speed settings had on exposure and depth of field (figure 3). Because of time constraints during the summer session, the prints were transferred to video tape by the instructor rather than the students, and put aside for a later laboratory assignment. The students had observed the techniques for placing photographs to video and would use this technique for a photo essay assignment and later for the graded video assignment. At this point the instructor focused on how still photographs are used in the context of creating a video and did not want to consume undue laboratory time repeatedly carrying out the technique of transferring the many photos needed for the laboratory video.

f stop 16
shutter speed 1/125

f stop 1.7
shutter speed 1/125

Figure 3. Effect of Aperture Settings on Exposures.

Video assignment

Prior to performing the video assignment, each student was given a video recorder and practice tape to handle. The instructor reviewed the operation of the recorder and the techniques covered in the assigned readings as the students followed along. For the actual assignment, pairs of students were given one video camcorder and video tape and instructed to take video footage of the structures and grounds comprising the College of Education. They were made aware that this footage should fit into a video tour of the campus along with the still photographs taken earlier. Suggested areas for recording were the terrace garden area and the college grounds where students sit and read or relax. Each pair of students was also instructed to interview a faulty member or a student about Iowa State. They were reminded of the video techniques covered in the assigned readings.

Upon returning to the classroom, some students realized that they overestimated their skill in the use of this technology that has become somewhat of a household item. One group inadvertently turned the recorder off each time they attempted to record the landscape or an interview yet video recorded their feet and captured their personal conversations as they walked along. Other groups experimented with in-camera editing by incorporating cutaways or motivated cuts in their footage. Viewing the exercise footage was both instructive and entertaining for the instructor and students.

Video editing assignment

Working from the photography storyboards, the instructor developed a script and then used the audio sound room equipment to narrate the script and background music onto a video tape (Figure 4). Three copies of this tape were made to serve as master tapes in the video editing assignment. The student groups worked together at the three video editing stations inserting footage from the tapes created from the photography and video assignment onto the master tape (with sound track only). Because of limited laboratory time, no one group attempted to insert all the graphics indicated on the script but instead began the assignment at staggered points in the script. Each group member had the opportunity to perform at least one video insert. The exercise was extremely challenging because the points for appropriate inserts were cued by the narrated script, yet the instructor's voice was barely audible when using the editing stations. Though this was unfortunate, the frustration alerted the students to the need to select a narrator with the desirable voice quality and adequate recording volume when creating their graded video project assignments.

As we leave the Union's front entrance we have a nice view of the Campanile. This memorial was rededicated by the current university president and chimes out various musical renditions usually over the noon hour. You can also set your

watch by the campanile clocks for they ring on the quarter hour.

still photo on video from Elmo

Figure 4. Excerpt from video script.

Audio and Dubbing Assignment

Though the audio sound room was demonstrated, the students did not have significant hands-on experience with the equipment up to this point. As pointed out earlier, the instructor produced the sound track for the video editing assignment in order to conserve time and model audio production techniques by giving them a product to work with that incorporated the various techniques (i.e. fade ins). Student groups would need to produce such a sound track for their graded video projects, therefore they were given laboratory time to practice the use of audio production techniques. The three groups of students rotated with one group in the audio room while the other two groups worked at the video dubbing stations. Each group of students laid a different portion of the sound track using the script that the instructor created. This exercise was for practice only and did not affect the final laboratory videotape.

During this same time period, one group of students at the dubbing station copied their portion of the video editing assignment onto the tape that would be the final video laboratory product. The second group simply watched and facilitated the copying process. The rotation schedule for audio and dubbing stations follows:

First 10 minutes
group 1— copy your video assignment to the master video tape (group 3 watches and facilitates)
group 2— lay your portion of the practice sound track

Second 10 minutes
group 2— copy your video assignment to the master video tape (group 1 watches and facilitates)
group 3— lay your portion of the practice sound track

Third 10 minutes
group 3— copy your video assignment to the master video tape (group 1 watches and facilitates)
group 1— lay your portion of the practice sound track

Once the three groups had rotated through the dubbing station, the three video editing assignments had been transferred to one video tape - the final video laboratory product. The students and instructor returned to the laboratory classroom to view and critique the final video.

Conclusions

From the instructor's perspective, the success of this approach, teaching various technologies in context, was determined by how well the students adapted the photographic and video techniques used in the laboratory assignments to create their graded video projects. By the end of the second week of this four week course, the students had divided themselves into three groups and had chosen the topics for the video projects on which they were to collaborate. The only parameter supplied by the instructor was that the topics of the videos focus on social issues. After a lively whole class discussion in which the instructor offered no input, the students decided upon 'staying in school', 'recycling' and 'elder care' as video project topics and the individuals grouped themselves according to shared interests in the three topics. The three groups had to work on the projects outside of class or laboratory time. The video project consisted of a script and videotape that used a continuous sound track onto which still pictures or video footage were inserted.

The instructor evaluated the three projects very highly in that the video scripts and tapes met or exceeded expectations. During the production process, the student groups exhibited a high level of enthusiasm for and commitment to the projects. This seemed to result from being involved in projects in which the group members had an interest or personal involvement. For example, the group working on the topic of elder care expressed a desire to produce a high quality videotape that could be used by a care provider in the area. A second group became interested in having their video about Iowa State's efforts at recycling shown on the campus television station. Teaching the 'how to' technologies in a context in which the students could relate and subsequently allowing them to apply the new knowledge in contexts that were of personal interest or linked to personal experiences seemed to contribute to the success of the photography and video unit. Furthermore, success also appears related to the fact that the students were able to see how the techniques taught in the laboratory actually fit into producing the laboratory product and were later able to draw upon the laboratory experiences when involved in similar projects such as the graded videos.

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EDUCATIONAL LEADERSHIP

Section Editors:

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This section on Educational Leadership discusses a variety of salient issues regarding leadership. Leadership comes from many sources. The reader will see in the articles traditional leaders, principals, and what we may consider non-traditional leaders in education, students. The articles seek to solve issues that challenge and force changes in our educational environment. Change occurs when the climate is conducive to efforts brought on by the leader.

In this section the authors have viewed leadership through multiple lenses. These lenses include leadership and technology and educational reform. Technology is a hot item with the increased funding from public and private funds. With the increased funding, traditional leaders are trying to implement technology without the knowledge or the support to do so. Policymaking is another area that needs to be addressed as educational reform is debated.

The following is a brief synopsis of the papers included in this section:

Aguilera and Mims and McKenzie's papers describe how practicing administrators lack essential knowledge and skills in the area of technology. Administrators can improve the use of technology in their schools by becoming familiar with it themselves.

Carlson discusses the systematic policy formation as it contributes to the strategic planning process for school technology.

Cathey, Chaffee, and Sharp's paper describes in detail the SWAT team approach to integrating technology into the curriculum revolves around the creation and development of a core group of teachers from different disciplines who act as a catalyst for change within their curricular area. SWAT stands for Savvy With All Technology.

Facciola and Roberts shows how many administrative hurdles need to be removed in order to enhance the benefits students receive from using computers. These hurdles include budget, training, support, staffing, changing roles, usage policies, and community access.

Hamilton, Eagleton, and Corkill discuss the lure of bells-and-whistle technology that leads districts in making hasty decisions when purchasing. Without a clear vision of how to successfully implement technology will lead spending huge amount of public money or relying on repeated bond issues. Levine also looks at making appropriate strategies in realizing the maximum benefits of using technology.

Heflich looks at the impact of technology on changes in teacher practices and student learning. This paper attempts to clarify relationship between school culture and technology and how this understanding is needed in the face of school reform.

Kauffman and Hamza discusses ten fundamental ideas to change our educational systems function within an Industrial Age economy to an Information Age economy.

Kirby focuses on the realm of variables that influence distance education in terms of student performance. This article compares distance education classroom to a traditional classroom.

MacNeil and Delafield's paper shows how technology has the potential of reforming education. The key person in this is the principal. It asks principals to rate the importance of technology implementation and professional development.

MacNeil and Harmon discusses how technology can enhance human contact and facilitate interpersonal communications.

Queitzsch shows how a neutral organization, Northwest Educational Technology Consortium, can be used to facilitate outcomes in using technology in a pre-service education program.

Riedl, Smith, Ware, Wark, and Yount explores attitudes, skills, and knowledge needed to support a technology-rich environment. Deminico also looks at the attitudes of educational decision-makers about technology use.

Schulz-Hamsa discusses the forging alliance between inclusion and technology.

Stockebrand and Altoff looks at the seven core values which U.S. citizens agree should be taught in school. Phi Delta Kappa has developed the League of Values-Driven Schools and discusses how this will lead education into the twenty-first century.

Sullivan and Keating administered a survey to determine computer literacy amongst principals and also the training needs.

The Early Adopters discuss an option of providing leadership in the implementation of technology. Students may provide an option to complement administrators' role as a leader.

Wark, Beasley, Erwin, and Zimmerman's paper explores a proposed model to provide administrators with a workable method to connect assessment, School-to-Work initiatives, technology, and students.

Zimmerman and Wark look at the development of teachers' technology skills and the integration of these skills into their content area classrooms.

Educational leaders have many issues to explore as we near the twenty-first century. The articles in this section provide insight in the use of technology, educational reform, policy making, and fundamentally who are the faces of our leaders.

The Early Adopters: Rhea Walker, Polly Mumma, Debra Kurth, Stacey Long, and Stephanie Sasser; Center for Technology in Learning and Teaching, N108 Lagomarcino Hall, Iowa State University, Ames, Iowa 50011, Email: tea@iastate.edu, Web Page: http://www.educ.iastate.edu/ctlt/tea/homepage.html

Basic Technology Tools for Administrators: Preparing for the New Millennium

Raymond Aguilera
The University of Texas at San Antonio

Joen M. Hendricks
Our Lady of the Lake University

Picciano states, "While the effectiveness of computers in instruction continues to be debated, the effectiveness of computers to provide information, manage budgets, and improve operations has been accepted (1998)." Administrator's can help improve the use of technology in their schools by becoming familiar with a few basic computer software tools. The Association for Supervision and Curriculum Development (1997) discusses various uses of current technology in our schools today. Cornett (1983) stated that the person most responsible for the success or failure of a public school was the principal. Most university preparation programs meet their state's administrator certification requirements by offering a series of courses, focusing on knowledge, not on skill development. "Few critics propose solutions or even clear directions for improvement," (Witters-Churchill, L. W., & Erlandson, D. A. (1990). Most students in the author's administrator preparation classes, both at the principal and superintendent levels, indicate that they know very little in the area of technology. The knowledge level of practicing administrators is also very poor. As a former superintendent of schools, the author also found that practicing administrators lacked essential knowledge and skills in the area of technology. With university preparation programs for principals viewed as less than adequate (adequate (Finn, 1986; Gorton & McIntyre, 1978; Hills, 1983; Kelley, 1986), it is imperative that present and future administrators learn these tools very quickly and effectively.

Browsing and Using the Internet

The Internet gives administrators the ability to communicate with other people and computers worldwide (Ryder & Hughes 1997). It is also a communication tool for gathering information available instantly from around the world. Rather then learn the history or detail about the Internet, the author suggests using the Internet for short periods of time over a semester. The following are suggested steps for learning the Internet:

Step 1. Use a computer with the capability to read Microsoft word files and which is connected to the Internet or Web. This is necessary for using this document to its maximum potential.

Step 2. Your first task is to become familiar with the Internet by accessing the author's activities from the Internet. This can be accomplished by using the following address (or by clicking on the following Web locator if this manuscript is read on a computer): http://www.csbs.utsa.edu/users/raguiler/fin1.htm. More structure and information on using the Internet is available on the Internet by accessing the Internet Handbook at http://home.netscape.com/eng/mozilla/2.01/handbook/. Complete all the activities on this particular Web page. The objectives for this assignment are: a) A student will become familiar with and use the Internet. b) A student will become familiar with icons used on the Internet. c) A student will be able to conduct a "search" on the Internet. Once the first assignment is completed, advance to the bottom of the assignment and click on Assignment 2: http://www.csbs.utsa.edu/raguiler/fin2.htm. Once the two assignments are completed, a student's knowledge level about the Internet should increase greatly providing the foundation for more in-depth and personal Internet searches.

Organizing Your Favorite Web-Sites

As you learn to navigate the Internet, you will find Web pages of interest and may want to use them again at a later time. The Favorites Icon allows you to save and list all the Web pages that you would like to use at a later date.

Step 1: Find a Web page on the Internet that you would like to use in the future.

Step 2: Click on the Favorites Icon

Step 3: Click on the Add to Favorites Icon

Step 4: Repeat steps 1-3 as you find other Web pages of interest to you.

Once you have completed Steps 1-4, you can view the list of bookmarks that you have added to the computer. By

clicking any of the bookmarks on the list, you can revisit that particular Web page.

Organizing Your Bookmarks

As the list of favorite sites increases, the listing should be organized in a meaningful way by creating "folders" for each main category of bookmarks. For example, by creating a folder entitled "Personnel," you would "click and drag" any bookmark from your list into the "Personnel" folder. You simply review your listing of favorite Web pages and determine the major categories for each folder to be developed.

Step 1: Click on the Favorites Icon

Step 2: Click on the third yellow briefcase icon to create your new folder.

Step 3: Type the name of your new folder (i.e. Personnel).

Step 4: Click on the "OK" icon.

Step 5: Click on the "Add" icon. You have now successfully added a folder entitled "Personnel" into your favorites listing.

Step 6: Repeat Steps 1-5 for adding additional Folders to your list of favorites.

Step 7: Once you have completed creating the major Folders, click on the "Favorites" Icon, click on the "Open Favorites" Icon to get to your list of Web page, and "click and drag" each Web page into its particular folder. Other folders that may be useful to an administrator are Legal Issues, Classroom Support, Grants and Resources, Student Sites, and Schools on the Web. You may create a "Miscellaneous" folder to handle those Web-pages that do not fit into the categories that you have created and place the remaining Web pages into this new file.

Other Interesting Web-Sites for Administrators

Job Searches. If an administrator is interested in searching the Internet for employment opportunities, the following Web-sites provide a good start:

- American Association of School Administrators Job Bulletin: http://www.aasa.org/jobs/jobbul.htm
- Texas Association of School Administrators' Job Bulletin: http://www.TASAnet.org/cgi-bin/jobs
- Texas Education Agency Job Bulletin: http://www.tenet.edu/unite.html

Legal Sites. The Internet also serves as a good source for information on legal issues. The following sites provide the springboard for legal information:

- Law by Country: http://www.law.emory.edu/LAW/refdesk/country/foreign/
- Legal Material by Topic: http://www.law.cornell/topical.html
- Legal Research Jumpstation: http://www.paralegals.org/LegalResources/home.html
- Yahoo! Legal Research Libraries: http://www.yahoo.com/Government/Law/Legal_Research/Libraries/

Professional Organizations. Information on many professional organizations is now available on the Internet. Other organizations are generally available through these sites.

- Association for Supervision and Curriculum Development: http://www.ascd.org/
- American Association of School Administrators: http://www.aasa.org/
- Texas Association of School Administrators: http://www.TASAnet.org/
- Other Organizations: http://www.yahoo.com/Education/Organizations/Professional/

Using an Electronic Spreadsheet (Microsoft Excel)

An electronic spreadsheet can be used to assist an administrator in organizing and/or calculating data in a very quick and efficient manner. The limitations in the use of the electronic spreadsheet are generally limited to the level of expertise of the user. The following news address: news://csbs.utsa.edu/utsa.csbs.ed15103 will allow you to experience an electronic spreadsheet that has already been developed for some school activities. Once you have accessed the spreadsheet program through the Internet, simply follow the directions on each worksheet to complete this learning module.

Lesson 1: Using the Student Enrollment Projection

This module is designed to assist you in projecting student enrollment changes in your school or school district. It is based on a Trend Analysis Statistical Model and will require student enrollment data over a five year period. Projections are then made for an additional five years.

- Open the Excel Spreadsheet program
- From the File menu, open file in Drive A
- Once in Drive A, open "Aguilera"
- (If you performed these steps correctly, you should now be on page one of the Electronic Spreadsheet Program for Administrators (ESP) which is labeled *CONTENTS*
- Move your cursor around the spreadsheet and change the information in any of the cells with words in them. What did you discover?
- Now move the cursor to the various "red dots" found throughout the first page of this Electronic Program. Again, summarize what you see at every point having a red dot.

Lesson 2: Using the Salary Schedule

For your second operation, move to the next worksheet in the ESP Workbook: *SALARY SCHEDULE*. Explore the Salary Schedule as you did previously by placing the cursor

at the "red dots" throughout this worksheet. After reading the "notes" found in the worksheet, write down what you have analyzed about this worksheet. In other words, what will it do and how do you get the information.

Lesson 3: Using the Scattergram

The Salary Placement Scattergram is your next activity. Again, scan the worksheet with your cursor and describe the purpose of this module.

Lesson 4: Using the Salary Cost Module

The last module in this ESP workbook, is the *SALARY COST* module. What is the purpose of this module and what information can you hope to gain from the worksheet?

Lesson 5: Modifying the Enrollment Projection

This lesson is to designed to allow you to actually use each of the modules by inputting your own information into some of the ESP Modules. The reason you have been unable to change any of the modules or input information into them is that each of the worksheets have been protected. You will learn how to change the protection status of a worksheet by changing it to an unprotected worksheet. Once you accomplish this, the worksheet module will allow you to input information as required.

Step 1: Go to the *Enrollment Projection Module*
Step 2: Click on the *Tools* Icon on the top Toolbar
Step 3: Click on the *Protect* command
Step 4: Click on the *Unprotect Worksheet* command
Step 5: You are now ready to input information into this module, but you must be very careful. *Do not type any information into the red section of the worksheet.* If you do, you will lose the formulas built into the spreadsheet and the calculations will not be accurate. Type in the following numbers (do not type in any words):

Student Enrollment Five Years Ago: 40,000
Student Enrollment Four Years Ago: 41,000
Student Enrollment Three Years Ago: 41,500
Student Enrollment Two Years Ago: 42,200
Student Enrollment This Year: 43,000

What is the projected student enrollment for next year?
What is the projected student enrollment in three years?
What is the projected student enrollment in five years?
What is the purpose of the chart and why would you want to utilize a Trend Analysis in the first place?

Lesson 6: Modifying and Using the Salary Schedule

Step 1: Use the same process that you used in the previous activity for *Unprotecting* the Salary Schedule Module.
Step 2: Develop a salary schedule that is increased by 5% horizontally (across) and 4% vertically (down) with a starting salary of $23,500. What is the salary for a teacher at Step 2 with an M.A.? What is the salary for a teacher at Step 10 with an Ed.D.? What is the salary for a teacher at Step 5 with a B.A.?

Powerful Presentations

An electronic presentation is another approach an administrator should utilize for becoming familiar and confident with technology. Microsoft Office PowerPoint Presentation will be the software program described in this section. By following this module, you will be able to create a presentation with a title page, a bulleted page, and a bulleted page with clip art.

Choosing a Background for Your Presentation

Step1: Click on the PowerPoint Icon
Step 2: Click on "Template" and click the "OK" button to allow the selection of a background for your presentation.
Step 3: For the purpose of this lesson, move your cursor to the "Portrait Notebook" icon and click "OK."

Creating a Title Page for Your Presentation

Now you are ready to create your first slide. This step allows you to select the type of slide you will use from a variety of templates or Auto Layouts.

Step1: Place the cursor on the first Auto Layout and click "OK." You are now ready to create your Title Page.
Step 2: Place your cursor on the section of the slide, which reads "Click to add title", and follow the instructions. Type in the title and subtitle of your presentation.

Creating A New Slide

Step 1: To create a second slide, place your cursor on the "Insert" menu found on the toolbar at the top of the screen and click your mouse once.
Step 2: Click your mouse once on "New Slide." This action will take you to the Auto Layout section once again.
Step 3: Place your cursor on the second Auto Layout, which is a bulleted list, and click "OK."
Step 4: Follow the instructions on the Auto Layout for placing the title of this slide.
Step 5: Add the supporting information or "bullets" on the section "Click to add text." After each line of information or bullet is added, hit the "Enter" key on your keyboard to create another bullet. Continue until 3-5 bullets are entered on this slide.

Creating Additional Slides

Step 1: You will now create a third slide by repeating step 1 in the previous section.
Step 2: Place your cursor on the ninth Auto Layout, which will create a slide with text and clip art. Click the "OK" button.
Step 3: Add the title of this slide.
Step 4: Add 3-5 bullets on this slide as instructed by the Auto Layout.
Step 5: Double click your mouse on the drawing to add clip art. This action will engage Microsoft Clip Art Gallery that contains several categories or types of clip

art. Experiment with the clip art by placing and clicking your mouse once on the category you would like to see. For example, if you place the cursor on the "Animals" category, you will see several pictures of animals. For this activity, place your cursor on the polar bear and hit the "Insert" button. Congratulations! You have now created your third slide with clip art.

Saving Your Presentation

Step 1: Click once on "File" on the toolbar at the top of the screen.

Step 2: Click once on the "Save As" sub menu item.

Step 3: Type the name of your presentation: Sample Presentation

Step 4: Click on the "Save" button to save your presentation.

You now have the basic information to develop powerful electronic presentations. Your challenge is to continue playing with PowerPoint over the next year and learn to apply additional features found in this program. Try to make a presentation using PowerPoint within the next couple of weeks.

Summary of Your Lessons

Now that you have completed the Internet activities, the Electronic Spreadsheet activities, and Electronic Presentation activities, you should be more familiar with each of the applications that can be used immediately for improving your present position. The challenge you are now faced is to continue your personal development with these administrator tools and to begin experimenting with other technology programs.

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Creating Technology Policy: A Systematic Model

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Policy making involves guiding decision making over long time periods and wide areas of interest for leaders and resource managers. First (1992) ascribes three focused characteristics to policy making: functioning from a strategic perspective, providing developmental guidance and clarification for major objectives, and furnishing priorities for resource allocation.

Policy, then, provides the steering mechanism that enables planning to take place. It is a first step in the planning process that enables the establishment, clarification, and prioritization of strategic goals and objectives. The tests of successful policy are an examination of the program accomplishments to determine whether the intended beneficiaries are truly profiting from the initiative and a judgment about the fairness of the policy to all constituencies. This paper will examine systematic policy formulation as it contributes to the strategic planning process for school technology.

Levels of School Technology Policy

Policy affecting school technology exists at three distinct levels that correspond with the three general governmental levels: federal, state, and local. It is not by accident that these levels exist. These levels represent the three hierarchical units that exhibit fiscal control over the schools, since one of the primary characteristics that determines policy is resource allocation. The entity controlling the resources frequently sets policies concerning use of the funds.

Federal policies that affect local technology policies are typically global in scope and funded above local levels, if they are funded at all. They are frequently promulgated by public laws or the resulting interpretation and implementation of these laws. A current example of this is the challenge for this nation "to connect every classroom in America to the information superhighway with computers and good software and well-trained teachers" (State of the Union Message, Jan 23, 1996). The President and Congress provided further policy guidance in this area with the passage of the Telecommunications Act of 1996 (McDonald, 1996).

State policies tend to be more focused on practical and specific issues. Legislatures play a major role at this level, although governors may wield some influence, as has been the case with Governor Zell Miller in Georgia. His policy on the use of lottery proceeds to fund instructional technology throughout the state has been uniquely applied because it must be used to fund "new" programs (Tucker, 1992). Of the thirty-six states and the District of Columbia that have established lotteries as a means of raising funds (Keating, 1996), Georgia's policy stands out as the one that has not offset funds in the general revenue stream (Allen, 1991; Jones, 1994; Jones & Amalfitano, 1994). These funds have provided a realistically funded mandate to local policy planners.

Local policies reflect the cumulative effect of federal and state policies, but have a unique local flavor added to this level. That is because policy reflects the community values and needs and each community makeup is different. Technology policy in the Silicon Valley of California is much different than that of rural southeast Georgia. Employers require different skills and competencies and the general community expectation is different. School technology policy, then, is framed by these three very different influences. Given the competing nature of the policy influences and the fact that budgeting is usually a zero sum game, how does one form a rational technology policy?

A Systematic Approach To Policy Formulation

Policy does not appear. It must be formed and nurtured past many gray areas and hidden obstacles before a policy can be implemented. A systematic approach to policy formulation will enable policymakers to establish realistic policies in reasonable time frames. The Policy Formulation Model in Figure 1 is a process that can be used to guide policy formulation. Central to the process is the goal. The goal is the guiding force — the focus of the entire process. Circumscribing the entire process is evaluation. The evaluation element enables the process to continually be checked for adherence to the stated goals and objectives, which should reflect law at all three levels. In addition, the goals and objectives are continually subjected to the scrutiny of objective reality. This provides realism for the process.

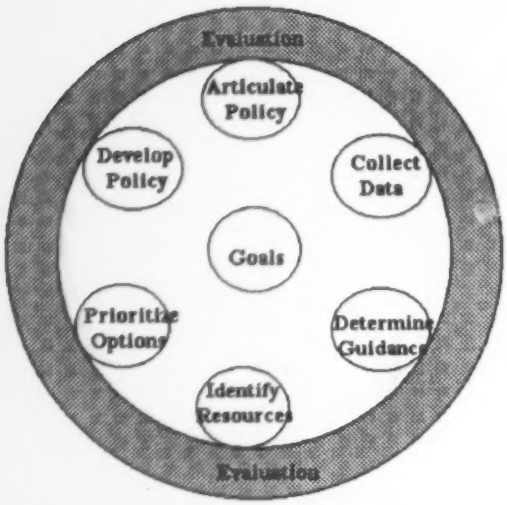

Figure 1. The Policy Formulation Model.

The six elements that ring the goals may be accomplished in any order. This nonlinear approach allows accomplishment of these elements to be determined by the application context or the particular local situation. It should be recognized that very frequently, these elements are accomplished in more-or-less sequential fashion, beginning with either "Collect Data" or "Articulate Policy."

Beginning at "Articulate Policy" recognizes that policy formulation is a never-ending, circular process. Policy formulation may begin after a pseudo-policy is formed. Data are then collected and the rest of the systematic elements performed in order to verify the original policy formulation idea. Alternately, an existing policy may be examined to confirm that it continues to meet the tests of a successful policy. Current policy can be subject to the scrutiny that the systematic policy formulation process brings. In this manner, the process can be thought of as an evaluation process, either formative or summative.

Beginning at "Collect Data" recognizes that as one begins to formulate policy, one must gather as much data as possible about a circumstance prior to looking at policy alternatives. In this form, there are far fewer preconceptions about what the policy should be, therefore fewer alternatives to discount.

Goals

The goal of the policy can be determined from sources both internal and external to the system. External sources may be superordinate legislative or administrative bodies, state or federal governments or agencies, certifying bodies or professional organizations, or community associations. Goals can be specific or philosophical, for example, "Students will take 2 years of a foreign language in order to graduate with a college preparatory diploma," or "Students will graduate prepared to meet the challenges of the 21st Century." Internal sources are likely to be the stakeholders — the administration, teachers, and students. These stakeholders may raise an issue that they feel should be focused on, such as "Students should graduate from secondary school with better research skills." These goals are set up as a "strawman" to be verified, better articulated, and enhanced, or through the policymaking process, they will be modified or discarded.

Collecting Data

One must first of all decide upon the kind of data that must be collected and the motivation behind the data collection effort. Data are collected for two general reasons. The first is to articulate or validate the goals that drive the entire process. These data could be "hard" or factual, but are more likely to be opinions. The difference is an important one for policymakers to recognize. Factual data can be verified by sources independent of one individual or group. For instance, the statement, "The students at Wayland Elementary School do not have enough access to technology," may or may not be supported by the fact that in each classroom there are 5 multimedia computers hooked up to the internet, a TV with satellite feed, a videodisc, and a VCR, with access to 125 different software titles and 100 videotapes in the media center.

The second general reason for data collection is to specify the target state and the current state. The target state attempts to identify the situation that must be attained while the current state represents the existing situation. These states are sometimes called "what should be" and "what is." This type of data is more likely to be factual than the preceding type. Using the technology example again, one may collect data on required technology and also existing technology.

Data collection of factual information may be accomplished through existing (sometimes called archival) records, observations (depending on the characteristic observed), and tests; opinions may be accomplished through interviews, focus groups, questionnaires (surveys), or community forums. Factual information is most likely to be collected using quantitative data collection techniques, while opinions are most likely to be acquired through qualitative data collection techniques. Numerous books are written about data collection. For this discussion, it is sufficient to say that after data are collected, the goals can be verified and refined providing the policymaker with a stronger basis for understanding what the target state should be and the current state is.

Supporting the general goal of "schoolwide technological literacy," the policymakers may collect data on the target state. They may research existing law and higher level policy to discover current guidance. They may send out questionnaires to similar schools throughout the state, region, and nation to find out what motivated the existing policies and

the strength of the feelings for those policies. They may conduct interviews with specific individuals who have special expertise in the area or whose opinion would be particularly helpful in the situation. They may conduct focus group studies to find out opinions of teachers, students, or other affected groups. They may conduct community forums to find the community feelings.

Determining the current state is frequently easier, because one is trying to find "what is" instead of "what ought to be." To do this, one must simply go on a fact-finding trip — in fact, much of the data can be collected concurrently with the target state data. This data is dominated by factual data. Examples of the data and collection techniques may be:

- research of existing measures of accomplishment, such as standardized test scores, attendance, or discipline incidents.
- surveys of the stakeholders (teachers, students) to determine current level of accomplishment or they may conduct a focus group to try to get the same type of information.
- interviews of other stakeholders (principals, curriculum specialists, media specialists) to determine their perceptions.
- observations of the use of technology in the educational process.
- looking at existing records, such as equipment and facilities' records.

Determine Guidance Needed

Once the data have been collected, the policymaker must then compare the data concerning the current state to that of the target state. This may be a straightforward, simple task as may occur when a new goal has been added to an organization's mission. It also may be complex, with many interacting components. The policymaker in this instance must organize the data in such a way that the differences between the current and target states are identifiable.

One aid in the accomplishment of that complex task is to build a table (Table 1). List in the columns the state and in the rows the characteristic. A helpful tool to use for determining the characteristics is the concept map (Figure 2). The policymaker must list and relate the essential characteristics of the goal. Once the characteristics have been described concerning current and target state, the gap should become apparent and the policy need established.

Identify Resources

Resources and the correlated constraints should have already been identified during the data collection phase. It is helpful to list these as we begin to solve the problem being researched. In that way, it is easier to realize where our strengths and weaknesses are. It is helpful to look at these from a positive aspect — "What can I do to maximize the potential strengths?" One must avoid the tendency to dwell on the constraints. However, these constraints may point to the need for a policy. Examples of resources may include time, funds, personnel, equipment, facilities, space, materials, group identification, philosophy, and organization. From this list, one can identify areas where solutions may evolve and areas that may be in need of further research and problem solving.

Table 1.
Needs Resolution Format.

	Target State	Current State
Budget		
Resources		
Training		
Access		
Support		

Figure 2. Concept Map.

Prioritize Options

It is not unusual for the policymaker, especially when working with many goals, to identify the need for several policies in numerous areas. The process for arriving at the needed policy is one of brainstorming solutions and prioritizing the possibilities. Brainstorming solutions is a technique familiar to many planners (Jonassen, Hannum, & Tessemer, 1989). It involves systematically generating lists of possible solutions. These possible solutions are not initially judged on their merit. Their value is to provide an exhaustive list of possibilities and to generate other solutions. The method for building the list is not important. It may be generated on butcher paper in a community forum or through the electronic equivalent, a user group.

Once the list of alternatives is generated, then the list must be prioritized according to some criteria. Frequently the criteria are established when the goals are generated. If not, the criteria must be established before the prioritization can occur. Criteria may include:

Size — biggest gaps or the largest policy needs

Importance — the most critical gaps or policy needs

Number of persons directly affected — the policy needs of the largest audience

Risk — the policy needs that carry the greatest negative consequences if they are not performed

Feasibility — policy needs that have the highest probability of being successfully accomplished

Cost — the lowest cost policy needs

Political reality — the policy needs of the most powerful or most vocal group

Methodologies for arriving at prioritization include various types of Delphi techniques, card sorts, Q-sorts, nominal groups, and storyboarding (Murray-Hicks, 1981; Scott & Deadrick, 1982; Witkin, 1984).

Develop Policy

This step is actually selecting from a list of options prioritized according to some criteria and preparing to implement the policy. Solutions to policy needs have been systematically discerned and prioritized according to various criteria. These solutions may be chosen from one or a combination of the criteria. An easy way to combine the various criteria is to construct a matrix (Table 2). That matrix may be filled in with simple numerical data (ranking or rating on criteria 1, criteria 2, etc.) and then the overall ranking determined numerically. There are various other analytical approaches to determining the choice of solution such as the Paired-Weighting Procedure (Wickens, 1980) and Force-Field Analysis (Lewin, 1947).

Table 2.
Prioritization Format.

	Criteria 1	2	3	4	5
Total					
Solution 1					
Solution 2					
Solution 3					
Solution 4					
Solution 5					

Yet, a policy is more than just a prioritized list. It must be workable and it must solve the problem that was identified. Therefore, before any solution is chosen, it should be reexamined in light of those criteria. Workable includes being supportable by the stakeholders that are affected by the policy. Meeting this criterion can be aided by the policymaker's actions throughout the policy analysis process. If stakeholders are kept informed and their concerns are faithfully considered during the analysis, they are more likely to support the policy. Of course, any solution that does not solve the identified problem should be rejected.

Evaluation

Evaluation by its very nature takes on two forms — assessment of how well the policy development process worked and determining if the policy fulfills the goal. Evaluators use the terms formative and summative evaluations for these two processes.

The policy formulation process is by its very nature continuously subject to the formative evaluation process, if properly conceptualized. The circularity of the process requires that each element of the process be examined for consistency and relevance. One may see that if the process depicted in Figure 1 is completed at "Articulate Policy," it leads back into another cycle of data collection, identification of resources, etc. The reason that the evaluation ring surrounds the entire policy formulation is due to the circularity of the process. It also serves as a reminder for policy formers to continuously evaluate each element in the process. Experts in research design should review data collection. Likewise, each element should be reviewed for adequacy. Experts from within the system are recommended and most usually chosen because the nature of the evaluation subjects the evaluator to low amounts of bias risk (Worthen, Sanders, & Fitzpatrick, 1997).

On the other hand, summative evaluators normally should be chosen from outside the system implementing the policy (Worthen, Sanders, & Fitzpatrick, 1997). Bias risks mount when evaluators from within a system are asked to recommend an adoption or continuance decision. That does not mean that there is no risk of bias from an external evaluator, but that the risk is lessened. This evaluator looks to make a decision based on whether the policy fulfills the policy goals, what are its strengths, what problems were encountered, and what results were unexpected. Ultimately, the summative evaluator must decide if the process would be used again and what changes should be made if it is used.

Summary

The policy formulation process model (Figure 2) contains eight elements. The model is focused on the policy goal. Six major policy formulation steps may be accomplished in any order because of the circularity of the process. Evaluation is continuous throughout the process.

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The SWAT Team: Successfully Integrating Technology into the Curriculum

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Madeira had been behind on the advancement technology as compared to many of the competitor schools. In 1995, a major push had started to bring technology to campus. The school funded laptops and desktops to all full-time faculty, and also provided a one week intensive training program by outside technology consultants to bring the faculty up to speed on how to use their computers. The groundwork had been laid for getting technology into the classroom by first giving the faculty the needed equipment and training. Eighteen months later, the faculty only superficial computer users. There had been little follow-up or continued training for faculty to increase their skills and confidence level. Unfortunately, the use was limited to prepare report card comments.

In the Fall of 1996, the cornerstone for the Savvy With All Technology (SWAT) team program was laid. The idea of SWAT was to infiltrate departments with technology specialists and users so that technology would be used across the curriculum in instruction and learning. Dr. Griffith and the administrative team at Madeira approved the Madeira Philosophy Of Technology Use mission statement. This clearly defined how technology would be incorporated and used in the school environment. The statement reads a follows:

> We believe that the integration of technology into our community provides us with vital learning and teaching tools, both inside and outside the classroom, and that the technology should serve to support, enhance and expand the educational goals already established by the Madeira community.

This paper will attempt to explain the SWAT program in detail, starting with the program vision, goals, and objectives. Member selection and expectations will be discussed, as well as supporting programs that enabled and facilitated the SWAT program. Two specific projects spearheaded by the SWAT program will be discussed showing the impact of technology application in the classroom through teacher instruction, student-teacher interaction, and student learning. Finally, the next steps for the program will be highlighted as Madeira looks ahead to more integration of technology into all the classrooms.

The SWAT Team Vision

With the mission statement in place, the SWAT team would have direction and purpose in their work. The vision for the SWAT Team was three-fold:

- to create a formal vehicle for integration of technology into the curriculum
- to foster technology leaders in the classroom
- to form a technology support group.

It became obvious that two teams were needed on campus: an academic group and an administrative group. Both had specific concerns, needs, and technology issues, and both could be facilitated through a group forum. Therefore, an academic SWAT team was created to focus on integrating technology into the curriculum and an administrative SWAT team was created to focus on how technology could facilitate work flow and information exchange within and among the different constituents on campus. This paper specifically focuses on the formation, implementation, and successes of the academic SWAT team.

Member Selection

SWAT members were selected using input from several sources. To be a truly representative team, the team needed to be composed of a member from each academic department plus a representative from the library. It was important to select someone who had some prior technology skills or special interest in technology. Each of the department heads were solicited for input about which department member would be their best candidate for the SWAT team. We also encouraged teachers to nominate themselves for review and participation in the SWAT program. After all the information was gathered, the candidate list was reviewed and the team was selected. Confirmation letters with the program goals and member expectations were sent out to the team. The SWAT team was formally recognized at the following faculty meeting as a new and vital part of the community.

SWAT Team Member Goals

The goals for the SWAT team members within each department were straight-forward and clear. Within his/her department SWAT team members:

- advocate technology
- provide leadership within his/her department and school-wide
- provide guidance and support to other department members as they incorporate
- technology into their teaching
- identify new software and programs for curricula area
- pilot a project in at least one course within the first year

SWAT Team Member Expectations

Additionally, there were performance expectations for each SWAT member. They are as follows:

- each academic department would provide one member to serve on the SWAT team
- each team member would make a three year commitment to the program
- members would attend monthly meetings
- members would provide informal training, support, and/or troubleshooting to his/her department members
- team members would receive a stipend or compensation for participation in the 1998-99 school year

SWAT Team Objectives

The first SWAT team meeting focused on setting the objectives for the coming year. It was also an opportunity for everyone to contribute to the establishment of the program's objectives. Creating a shared vision empowers the group and fosters ownership in the program. The successes became everyone's success and it also encouraged the members to work and achieve at higher level. The objectives established at our first meeting were:

- improve information exchange between academic and administrative offices
- integrate technology activities into the curriculum on a scheduled basis
- incorporate two technology activities per quarter
- establish new work habits that include technology (e.g., email)
- SWAT or Department of Technology (DOT) members would assist department faculty and staff in early lessons if needed

Additional Issues

It is also interesting to note that a significant amount of time was spent talking about how technology could help with tedious and repetitious school tasks. It became clear that technology was needed to help facilitate most of the reports that faculty were required to prepare on a regular basis. These reports included: report cards, interim reports, quarterly comments, and daily attendance. The administrative aspects of technology for faculty would be handled by the DOT separately, since they had nothing to do with classroom instruction.

The MEANS

At the beginning of the 1996-97 school year there was not a campus network at Madeira. There were several isolated networks in several of the administrative offices, such as Development and Business Offices, but none of these networks worked together or allowed for any information sharing. The first task was to get all of the offices, both administrative and academic, linked together. Systematically, the network was created using 10-Base T technology, Tut repeaters, and the Internet to establish the Madeira Educational Access Network Service (MEANS). For those offices and buildings that were too far away from the center of campus, a dial-in capability was established. Users from the performing arts building, for example, which is located about a half mile from the network operations control center, had the facility to dial-in to the network for Internet access and mail retrieval. It took about six months to get all eleven buildings on campus connected to the MEANS. Interestingly enough, within a year, the network traffic is so great that Madeira is now considering upgrading the backbone of the MEANS to a fiber optic network.

Implementation of Supporting Technology Initiatives for the SWAT Program

In order for the SWAT program to function, the Department of Technology needed to implement a series of supporting technologies campus-wide. The first of these was the establishment of a wide area network, the Madeira Educational Access Network Service (MEANS). It was crucial to connect all of the academic and administrative offices to the network in an effort establish better communications among all the school's constituents. The next step was the implementation of email for faculty, staff and students. Third, we standardized the campus productivity software to the Microsoft Office, so that everyone could easily exchange information. Fourth, Madeira connected to the World Wide Web through a T-1 connection. Additionally, the DOT provided training for faculty and staff during the school year and during the summer to raise the level of proficiency among the users. Lastly, the DOT provided technology grants to faculty and departments for additional training or equipment so that they could direct and implement the type of technology they wanted within their curricular area. A brief description of each of these initiative follows.

Email For Faculty, Staff And Students

Once the network was growing, the implementation of email campus-wide was the next logical step. In an effort to conserve costs, the DOT decided to use Eudora Lite for its email software. Eudora Lite, and now Eudora Pro, are free to educational institutions. We determined that if this proved

to be a successful form of communications in our environment, then we could upgrade to a more complex program at a later date. The implementation was done in a phased approach with the progression as follows: the administrative staff, the academic faculty and offices, the international boarding students, the rest of the boarding students, and the day students. Everyone on campus had an email account by the middle of March, 1997, and our daily exchange of messages went from zero to over 3,000 email messages.

Standardization Of The Campus Productivity Software

Another obstacle that prevented the most effective communications and information exchanges stemmed from the lack of a standard productivity software for all computer users. The administrative offices were using WordPerfect, both the DOS 5.1 version and the Windows 6.0/6.1 version, while the academic offices were using a similar mix of WordPerfect, Microsoft Works, and ClarisWorks, and the student labs had ClarisWorks. The admissions office had difficulty exchanging information with the development office, because document formatting would get lost in the conversion from one software package to another. The DOT proposed the establishment of a campus standard for computer productivity software so that everyone would be on the same.

The headmistress and the administrative team adopted the DOT's proposal to standardize the Madeira campus to the Microsoft Office Suite. The Microsoft Office Suite was selected for four reasons:

1. It supported the goal of technology integration into the community because it was a full-feature suite of productivity software that included word processing, spreadsheet, database and presentation tools.
2. It expanded our ability to communicate effectively and exchange information easily.
3. It is a package from an industry leader and stable company.
4. It is available for cross-platform environments where the functionality of the software on the Macintosh or the PC-compatible Windows machine are the same.

The Internet Connection. The method the DOT used to create the MEANS was made possible through the school's connection to the Internet. Netscape Navigator software was added to all the campus equipment in the student computer labs, the administrative and academic offices, and the library. In fact, a separate Internet research lab was established in the library to give students the opportunity to use the Web for research or information gathering anytime the library was open.

Faculty and Staff Training. The decision to move to a standard productivity software meant that all the staff and faculty would need training on how to use the new software. The training was comprised of two different tracks: the administrative track, providing six hours of intense Word training and file management, while the academic track consisted of nine hours of training focusing mainly on using Word, but also providing an introduction to PowerPoint and Excel. Training was provided on Windows 3.1, Windows 95, and the Macintosh Operating System. While training was optional, and there was no additional compensation. Approximately 60% of the staff and faculty attended the training sessions offered.

Technology Grants. The Board of Directors designated technology grants as a means of helping fund technology projects for the classroom. The DOT had allotted approximately $50,000 the previous year for a variety of department lead activities. For the 1997-98 school year, the DOT increased the amount of technology grant money to $75,000, approximately 50% of the school's technology budget, to facilitate and support SWAT team efforts departmentally. Major grants were awarded for both equipment and training to the science program, the performing arts program and the foreign language program. Additional grants were given to the librarians, history, and DOT members for specialized training of technology use in the classroom.

SWAT Projects for the 1997-98 School year

While all of the disciplines have been working on integrating technology into the classroom, two of the SWAT projects are real standouts. They standout for several reasons, but primarily because of the scope of their impact. The SWAT team projects have had a significant impact on teacher delivery methods, teacher-student interaction, and student learning. A description of each of the projects and the scope of their impact follows this introduction.

The Science Project

The science department proposed a full-featured technology grant that included a mix of equipment and training for all three of the science curricula. The biology and environmental science teachers wanted a cluster of four Macintosh computers to run a variety of course content-specific software, as well as enable students to use the Microsoft Office software to write up lab reports, construct data tables using Excel, and create presentations using PowerPoint. They also asked for a presentation system for instruction purposes which was composed of an AV Power Macintosh and 27 inch monitor. The chemistry teachers asked for a PC-compatible presentation system to facilitate lectures and the physics teacher asked for PC-compatible probes to gather data for use in classroom demonstrations and experiments. The entire grant was funded and the results have been astounding.

Daily, one can observe the chemistry teachers lecturing using the presentation system and delivery of the course

material through PowerPoint. Students are given the basic slides as handouts and use the outline as a guide for taking notes. The teachers felt that the students were able to take better notes since they were able to concentrate on the details of the lecture. The students felt the lectures were better organized, and if the discussion got off track it was easy to get back on track with the notes already in hand. The impact on both teaching and learning, as well as the method of instructional delivery, have all served to improve the educational environment.

The biology cluster and presentation system have been successful as well. The computers loaded with course content-specific software provided students the opportunity to experience the material they learned in a new manner. Students were able to watch mitoses and meiosis on their computer screen. They were also able to replay the events as many times as needed to understand the process. The teacher was free to assist those who need with more individualized attention, while others who grasped the concepts more easily could move ahead to more challenging parts of the same lesson. Personal exchange between student and teacher was dramatically enhanced.

Finally, the physics probes used in combination with the PC-compatibles in the physics lab have greatly facilitated data gathering and measurement. Students experience how professionals would gather similar information in a real lab environment and then use that data to draw conclusions about their subject matter. Here, the physics teacher assumes the role of a facilitator.

The Performing Arts Project. Similar to the science project, the performing arts project has three parts which focus on integration of technology into the curriculum. They are: technology in dance choreography, technology in the theater through set design and desktop publishing, and technology in music. All three facets of the performing arts project have had an impact on learning, instruction methods and the level of satisfaction with the final product.

The dance instructor has incorporated technology into the dance curriculum by purchasing choreography software to use in the advanced dance courses. Students will be creating their own choreography using the mini-lab of computers housed in the dance studio itself. Once the choreography is complete, the dancers can then have the class perform the dance as written and make adjustments as needed along the way. Students feel empowered to direct the class and the development of valuable leadership skills have been one of the additional benefits to the introduction of technology.

The theater director has incorporated technology into the theater arts classes through set design and desktop publishing. Plans for the set can be drawn and redrawn easily, and materials needs can be estimated at a tremendous savings. Desktop publishing is taught to create the programs for each production and the final product has dramatically improved since its introduction. The director, the students, and the audience directly benefit from programs that are clean, clear, and easy to read.

Finally, technology in the music program assists in helping students compose and arrange music. Many of the previous obstacles to musical composition, such as notation, arrangement, and changing the key, has been eliminated with the use of technology. Students can focus on the mood or feeling of the pieces more than the mechanics of which note is flat or sharp. It has encouraged students to compose music who previously would have never tried to do so, and has therefore, enriched their educational experience.

The Next Steps

The next steps for the SWAT program will be to take the successes experienced in the science and performing arts program and use them as archetypes for the other departments. The challenge of changing instructional styles in the history and English departments will be formidable as the faculty in both these departments are well-established professionals who have achieved a high level of success with the 'tried and true' methods they have used for many years. Additional money for training and an experienced curricular specialist will be one of the avenues to pursue.

Conclusion

The formation of the SWAT team at Madeira has significantly increased the use of technology in the curriculum as well as across the community at large. There are several key points to consider:

- For technology integration to be successful in our environment, it was essential that the ideas for use come from the ground-up and not from the top-down.
- The SWAT team gives individual members the opportunity to act as a sounding board and troubleshooter for each other as projects developed when problems erupted.
- The school must also dedicate its resources in making the program successful, which means staff development and money. Mission statements alone cannot bring about change. Supporting initiatives, such as network connectivity, and email, can expedite the entire project.
- Most importantly, persistence is the key to any successful program. Evaluate often what's happening often so that changes can be made for even greater success. There is no right or wrong with technology application; it is what is most appropriate in a given situation and what will be effective for the desired outcome.

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Assessment of Leadership Attitudes of Educational Decision-Makers on Technology Integration and Teacher Competence

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The purpose of this pilot study — an original research thesis: "Field-test of a practitioner-made instrument to measure the attitudes of educational decision-makers in New Hampshire on extended integration of technology-based learning strategies facilitated by well-trained and competent teachers" (1997, DeMinico) — was to investigate the attitudes of educational decision-makers about technology's benefits to education. An inductive questionnaire was developed to determine the answers to many general questions about technology-use. Was technology-use in schools something that decision-makers believed was preceding the future needs of citizens, or another dose of therapy for an ailing educational system that many outside observers considered as having failed? Was a consensus developing among decision-makers about how to manage a learning environment having vast quantities of new data, information, and knowledge? Could increased technology-use abate this phenomenon by encouraging students, teachers, and parents to become life-long learners with well-developed thinking and problem solving skills? Was increased support for staff development of well-trained and technology-competent teachers going to become the cornerstone of successful schools in the electronic age? Was technology-use as a productivity tool becoming a priority in order to better motivate students on learning how to learn so they could lead happy and successful lives as good citizens?

Hypothesis

The literature review suggested that technology-use in the hands of well-trained competent teachers can enhance the engaged learning process with authentic problem-solving and critical thinking activities. Specifically, the works of Jerome Bruner on "process-inquiry and constructivist scaffolding" and William Glasser on "quality schools" where students are workers formed the basis of the research hypothesis to discover answers to the many questions raised in the introduction. [1960, Bruner; 1990, Glasser] Assuming a valid data gathering process, it was hypothesized that a survey taken among administrators, teachers, and governmental decision-makers would reveal their attitudes about, or beliefs in, a relationship among the use of technology, well-trained competent teachers, and enhanced learning.

Instrumentation

The jury-validated questionnaire was framed to ask subjects whether they agreed or disagreed with certain sources of interest, Principles, Opinions, Methods, and Practices, concerning technology-use in schools. Each of the 90 questions on the survey were considered by the researcher to be generally accepted true statements on educational technology-use. All 90 questions on the survey were answered using a Likert scale from one (1) to five (5) with a range of specific determinants from strongly disagree to strongly agree, respectively. Most of the interrogatives used in the survey were gleaned from interpretation of information found on the Internet. The questions were stated in a straightforward manner without any intentional ambiguity or hidden agenda. Each inquiry was crafted by the researcher in a positive way based on widely accepted norms from documented successes in planning and implementing technology integration. An estimated reliability for internal consistency for the questionnaire was computed using Kuder-Richardson formula 21 for rationale equivalence (KR-21). The reliability coefficient was .92, standard deviation was 6.666, with a mean score of 86 out of 90 items on level of agreement versus disagreement. Using Pearson r, all groups within the category of sources were correlated in five comparisons with a mean coefficient of .96 and significant at $p < .05$.

Procedures

The judgment sample of subjects included all the superintendents from the 69 School Administrative Units (SAU), 10 randomly selected teachers (technology coordinators) from the membership of the New Hampshire Society for Technology in Education, and 21 governmental or non-governmental educational policy decision-makers. None of them were volunteers. The questionnaire was designed with an intent to build upon several accounting-like studies researching numbers and types of technology-use in education by focusing on ratios of equipment to students. However, as a departure from the previous studies and in order to avoid the usual angst over educational funding, the current study was designed to ask decision-makers about extended technology-use in a fiscally unconstrained environment. Questions were presented in a "category of interests" of principles, opinions, methods, and practices in the context of educational objectives and disassociated from funding. All subjects, in three "categories of sources" — Administrators, Teachers and Others — were administered the same questionnaire. The results from jury-validation by experts were used as a control.

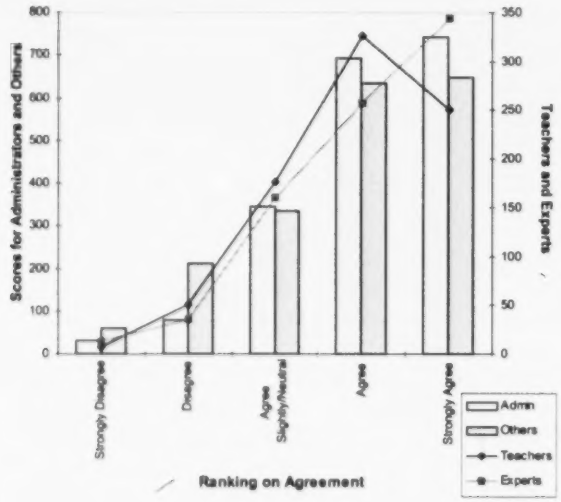

Figure 1.

Results

The practitioner-made instrument used to investigate factors influencing leadership attitudes of educational decision-makers on extended technology-use learning strategies facilitated by well-trained and competent teachers was determined as reliable and valid. The 90-item questionnaire using Likert-scale scoring sent to a judgment sample of 100 knowledgeable subjects in 3 categories of sources yielded results consistent with expert norms. Descriptive data was analyzed using a chi-square test to compare observed frequency counts of determinants with those expected. At an alpha level of .05, the results were significant, $p = .000119$. The null hypothesis was rejected in favor of the declarative, that a relationship existed between technology-use and learning. Group mean score was 96 percent with agreement on 86 of 90 items having a standard deviation of 6.66.

Conclusion

The estimated reliability (KR-21) for internal consistency of the survey instrument was .92 making the instrument appropriate for use with a larger cluster sample of similar populations. Generalizable results from this pilot study, however, were threatened by a small sample size. Nevertheless, the methods and procedures used seemed well-suited for future assessments by educational decision-makers to help them rationalize competing programs that are delaying modernization of American public schools with abundantly sufficient on-line networked computers.

Recommendations

Although there was significant agreement on technology-use being an effective learning tool, subjects felt that change will come about only if teachers are well trained. Therefore, teachers themselves should take the burden of responsibility for their professional development and personal competence in using technology in the classroom.

Teachers should be demanding more exposure to technology during undergraduate and graduate schooling. Certification for having basic skills to operate both a PC and MAC must become mandatory; otherwise, one-day Workshops will go right over teachers' heads.

Becoming computer literate is not an easy task, but talking the talk is not enough; teachers must walk the walk. They must find time to learn computing on their own time like other professionals, such as physicians and lawyers. Finding time can be facilitated by using computers to ease administrative burdens as well as teaching and learning.

Methods and practices designed for classroom teaching will also work for teachers who wish to learn about computing. The time-value of time spent on authentic tasks is invaluable. Drills, examples and demonstrations are a waste of time after one has achieved a novice knowledge-base.

This study was done to hone the computing skills of the author. Every facet of the project had a particular goal to learn more about a software application or piece of hardware or peripheral, and achieve mastery. The author through his own self-designed learning experience proved that "process-inquiry" works exactly as Jerome Bruner described it, and that a student must be made to work hard as William Glasser suggested. With enough effort in front of a computer screen, competence comes as magically as the day a child learns to read because technology is mathematically logical and follows a pattern of rational thinking.

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Interaction of Technology Based Classroom Innovations and Administrative Systems

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Introducing computer technology into teacher education programs offers a host of teaching and learning opportunities. Educators argue that computer technology promises everything from enhancing the delivery of instruction, to improving students' learning, to spurring the development of novel models of teaching and learning (Cole, 1990). At South Mountain Community College we sought to reap some of these technological advantages by building a computer laboratory specifically devoted to our Dynamic Learning teacher preparation program. We soon realized, however, that technology did not automatically bring about enhanced learning and educational reform. Instead, the introduction of technology created many challenges for our students, faculty, and administrators. In this paper we explore the challenges our campus faced in order to take advantage of the opportunities computer technology offered us. We examine three issues we believe were critical to our effective use of computer technology: the technology itself, the classroom learning environment in which we use technology, and the administrative changes needed to facilitate our instructional innovations. We emphasize how these factors led faculty and administrators to a dialectical process of discussion and action across campus to meet the needs of our students.

Classroom Technology

The first question raised by the introduction of technology into the classroom concerns the technology itself; "What technology should we use?" The options are vast, ranging from skill specific drill and practice software, through expert-like intelligent tutoring systems, to open-ended tools like word-processors and spreadsheets, Internet exploration, and simulation "games" like Myst and SimCity. The evidence of the effectiveness of the drill and practice programs and the "expert" guidance systems which provide learners much information and usurp most of the thinking is less than encouraging. Often this sort of computer application has minimal, transferable impact on students' learning (Spiro, Feltovich, Jacobson, & Coulson, 1991). It made more sense to introduce our group of prospective teachers to applications which might enhance what they will do as classroom teachers. Therefore, our campus decided to emphasize open-ended computer tools and applications which require learner thought and activity.

Our reliance on open-ended computer tools focused our classroom technology plan on two outcomes we hoped to accrue: effects with technology and effects of technology (Salomon, Perkins, & Globerson, 1991). Effects with computers occur when learner cognitive, affective, or behavioral performance is enhanced during computer usage. For example, if students write more polished essays than they otherwise would while using a word processor that offers grammar and spell checking, they experience an effect with technology. Effects of computers accrue when students grow as a consequence of working with computers. For example, students who compose better essays with only pen and paper after using software which provides composition guidance show an effect of computers. Both effects are prized learning outcomes for our prospective teachers.

Cultivating these two technological outcomes has tremendous benefit for our students. When experiencing effects with computers learners actually form an intellectual partnership with the technology in which students' performances exceed what they do without the technology. When the partnership is well-suited to learning, computers assume repetitive, time-consuming, lower-order tasks, allowing students to focus on more complex, higher-order thinking. For example, many word processing programs allow students to devote time and energy to language choices, organization, argument structures, and theme development by expediting spell checking, formatting, and writing mechanics. The partnership allows students to attempt higher-order, more meaningful tasks that would be difficult to attempt away from the computer. Further, to the extent that students have practiced these new skills, at some point they may be able to employ their new acquisitions absent the technology. Through the use of open-ended computer

tools, technology offers learners the opportunity to develop cognitive and behavioral skills that would be considerably more difficult to develop absent the technology.

While these computer applications offer important learning opportunities for our students, they do not accrue automatically. The value offered by open-ended computer tools presents a bit of a paradox. Most computer applications, especially those suitable for general teacher preparation, teach very little in and of themselves. Rather, it is the thinking in which students engage when using computers that results in learning (Salomon, 1992). Students won't cultivate the higher-order thinking skills computer applications offer, unless they expend the cognitive effort necessary to focus on them. For example, using a word processor helps students format, spell check, and generally polish their essays, but it does not teach writing skills. However, if students focus on higher-order structures of writing such as theme development, structural organization, argument analysis, voice, and language choices, word processing can help them develop excellent writing skills. Spell checking and formatting are great. But, the learning advantage of word processing comes when students use computers to free themselves from these relatively mundane, tedious, and time-consuming aspects of composition to focus on more challenging aspects like structure, theme development, and issue analysis. Clearly, it is the manner in which students use computer tools which fosters learning. Students must be mindfully engaged to benefit from computer tools (Salomon, Globerson, & Guterman, 1990).

In turn, it is the learning context in which students use computers which influences the quality of their thinking. When students find an activity unexciting or without real consequences, they are unlikely to expend the cognitive effort necessary to cultivate higher-order thinking skills. Thus, the challenge we faced in the Dynamic Learning program was to design a classroom environment in which students were willing to mindfully engage in their learning tasks and take full advantage of the learning opportunities the computer offered them. The key is that the learning environment must lead students to look beyond the surface features of computing and focus on the opportunities for thinking and learning that technology offers. It is the use of technology in the appropriate learning environment which accounts for student learning more so than does the application of technology or novel learning environments alone (Salomon, 1992).

Classroom Learning Environment

The Dynamic Learning Program at South Mountain Community College is our attempt to build a classroom learning environment that invites students to mindfully engage in their studies, particularly when using computer technology. Dynamic Learning offers the first two years of a university articulated professional teacher preparation program. A new cohort of students enters the program each year, completing their four semester sequence together as a learning community. The cornerstone of each semester is an integrated block of general studies and education courses taught from a single syllabus. Each block meets about three hours a day for three days each week, and is taught by a team of three faculty members. Due to laboratory course requirements, at least one course each semester is taught outside of the block format. Students also participate in a field experience each semester in local elementary, middle, and high schools, working closely with students, teachers, and administrators from these institutions. This program design allows Dynamic Learning students to study in an environment that is authentic, collaborative, interdisciplinary, and inquiry-based.

Dynamic Learning features authentic learning activities which have impact on students beyond their academic merits. For example, instead of giving public speeches only in the classroom, students earn course credit by speaking in venues outside of class. In particular, students have numerous speaking opportunities in their field experience, working with faculty, administrators, and students at those institutions. Since students choose these speaking engagements themselves, they have personal significance and the event has meaning beyond its course credit. The presentation graphics, outlining, and organizing students do at the computer has significant value to them because they are judged, not only according to classroom standards, but by professional standards by the students and staff at their placement schools as they present lessons, in-service sessions to teachers, and policy proposals to administrators.

The environment is collaborative in many ways. Students work in cooperative teams. They work with students and faculty from the university, high school, and elementary levels. They also work with members of the community on a regular basis as part of their studies. Technology facilitates this collaboration. Since our "classroom" now extends beyond its traditional walls into local schools, universities, government agencies, businesses, and neighborhood charitable organizations, computer-mediated communication is necessary to bring our students in contact with these parties. The planning, organization, writing, and interpersonal skills necessary to such collaboration become the real benefits of computer-mediated communication and the other applications students use in these ventures.

The program is also interdisciplinary in that courses are taught in "blocks" by teams of instructors. Instead of enrolling in a series of separate courses, students meet in a single three to four hour block each school day (9 - 12 credit hours a semester) in which they study several discipline areas simultaneously. Among other benefits, our interdisciplinary focus means we save time by not repeating basic information in different courses (e. g., outlining skills in composition and public speaking courses). As a result, students have time to delve deeper into their course

projects. This focus also encourages students to view educational issues with an integrative perspective. Thus, we spend less time on the basic issues of computer usage, less on the surface applications of technology to an issue (e. g., less on polishing an outline or essay), and more on the deeper applications of technology to real problems (e. g., what sequence of evidence and arguments might be most persuasive to a school board on a certain issue).

This is facilitated through inquiry-based studies in which students explore a theme, issue, or question with the tools of several disciplines concurrently. For example, a typical assignment for freshman Dynamic Learning students is to become agents of change on an educational issue of significance within the community. While students' projects have various levels of effectiveness, they all employ substantial writing, speaking, and critical thinking skills. In this context, technology becomes an important tool students need to accomplish personally relevant and meaningful goals. Students place a premium on computer time for crafting essays, writing letters, managing deadlines, brainstorming, creating charts and graphs, making presentation outlines and slides, organizing ideas, constructing models, conducting library and Internet searches, exchanging Email, testing ideas, analyzing survey data, and creating and using art, videos, and music. Because students complete these activities to accomplish their own purposes, they do so of their own volition, with attention to detail, and with concern for their results. They are mindfully engaged.

Our implementation of these four principles make the Dynamic Learning environment substantially different than the traditional college classroom. But, it is our application of computer technology within this innovative classroom learning environment which works to enhance students' learning. Computer technology affords students the opportunity to focus on higher-order thinking skills by assuming lower-order, repetitive, and mundane chores. The novel Dynamic Learning classroom environment entices students to take advantage of these opportunities technology affords by making their studies personally relevant and meaningful so that they mindfully engage in their work. Thus, heavy reliance on technology in an innovative learning environment has a reciprocal effect: Technology helps create an innovative classroom environment by bringing the community, ideas, disciplines, and people into the classroom. At the same time, our innovative environment makes technology educationally useful by encouraging students to become mindfully engaged in their studies with computers. The result for our students is enhancements in learning that are difficult or impossible without technology applied in an appropriate learning environment.

Administrative Changes

The changes we undertook in the Dynamic Learning classroom to support our technology-intensive focus happened neither automatically nor absent challenge. Rather, they posed numerous administrative hurdles for our campus to overcome. With the reliance upon the use of computer technology in the program, there were new capital budget demands and network infrastructure requirements that were negotiated and resolved. Questions of ownership, maintenance, and scheduling for the Dynamic Learning in-class laboratory of 25 computers surfaced. Since all block faculty were not equally skilled with computers, faculty training and support became an issue. Similarly, faculty office computers had to be upgraded and made consistent with lab computers for continuity. Training was needed for students as well as faculty, so that faculty could devote class time to teaching in their areas of expertise, rather than serve as computer tutors. The "real world" focus of the block encouraged students to make real use of technology, in turn, raising issues of student web page and server use policy. Provisions had to be made to bring Dynamic Learning off campus partners access to our technology and integrate our capabilities with theirs. And, our primarily faculty and staff focused Educational Technology Center now had to play a significant role in the classroom usage of technology. Each of these issues had to be addressed in order to support the technological innovations we introduced into the classroom. If any one of these had been ignored, the success of our project would have been greatly curtailed.

The development of learning environment we needed to maximize the educational effectiveness of our technology also posed several administrative puzzles. To start, the collaborative, interdisciplinary format required coordination and adjustments in the student advising process with needs for new advisor training sessions. In addition, this block format necessitated changes in the overall student registration process as students no longer registered for discrete courses but rather for packages of courses. Faculty at South Mountain Community College are contracted to teach a set number of course loads and have an established number of hours of accountability on campus each semester. The established course loading formulas and hours of accountability needed to be modified in order to support the block design of the curriculum developed by the three lead faculty. Broad course schedule coordination also became an administrative project with the need to offer the out of block courses at times which would meet the needs the student cohort. As a result, the program impacted a number of divisions and departments at the college requiring that new allegiances be formed. Faculty and administrators needed to work as a productive team to establish articulation agreements so that students completing the block program at South Mountain Community College could easily enroll in the upper division teacher education program at the local university. All of these challenges were brought about by innovations needed to maximize the instructional effectiveness our technology intensive program. Again, each of

these issues had to be addressed in order for the classroom innovations to succeed.

The Dynamic Learning Program at South Mountain Community College has resulted in a number of instructional innovations which have enhanced student performance, confidence, and persistence. Computer technology has been an important key stone to a number of collaborative and interdisciplinary approaches within this block program. Concurrent with these instructional innovations, a number of administrative processes and procedures had to be modified or developed in order to provide the needed support and structure for this program. Student performance and satisfaction demonstrates the Dynamic Learning program to be instructionally sound and effective. As a result of the success of the program, there has been concomitant campus impact in a number of arenas including policy, budget allocation, student services, schedule development, division to division cooperation, and articulation with other educational systems.

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Implementing Technology in Flowing Wells Schools: An Analysis of Leadership

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Technology is a liability, not an asset. Stories relating the expensive, difficult, and ineffective implementation of new technologies, specifically computers and communication equipment, in our public schools are all too frequent. Quality computers, within five years, go from top-of-the-line, productive, creative tools to forgotten plastic relics collecting dust. The lure of high technology unfortunately leads many districts into snap decisions that sound fiscal leaders can ill afford to make. Spending huge sums of public money or relying upon repeated bond issues without establishing a clear vision of what successful technological implementation should look like is fiscally, politically and socially irresponsible. Beginning with the end in mind; an oft-cited reference to the work of Steven Covey, is prerequisite in bringing about innovative and effective use of technology that promotes student achievement.

Core Values

Flowing Wells, a ten-school district in Tucson, Arizona, turned first to their written core values when beginning to craft their technology implementation plan. A poster in every class outlines the four values all employees are expected to share. First, all decisions will be student-driven, based on what is believed best for the student. Second, every employee will walk their talk and operate with integrity. Third, all work will be quality-focused, modeling the assumption that if something is worth doing it is worth doing well. Finally, the district will respect the decisions everyone must make to maintain balance in their professional and personal lives.

The public expression of these shared values created a framework facilitating the creation, adoption and implementation of the district's new technology initiative.

Climate for Change

District administrators, through the course of many years, have established communication and trust between themselves and the governing board they are accountable to. Board members and administrators strengthen this communication during annual summer retreats. At the start of fiscal year 1997, all decision-makers in the district were ready and willing to move forward with a new technology initiative. Additionally, a successful salary override recently raised teacher pay comparable to neighboring districts.

The importance of governing board, community and teacher support cannot be overlooked when considering the adoption of expensive new policies. The pacing and timing of major change efforts contribute tremendously towards their success or failure.

Collaboration

The leadership strategies employed by assistant superintendent, Dr. John Pedicone, coupled with the district's core values, articulated by superintendent, Dr. Phil Corkill, brought together a cadre of teachers, parents and administrators focused on assembling the foundation of the district's technology initiative. Under Dr. Pedicone's supervision, ad hoc committees were assembled around the following four themes:

- Curriculum
- Business and Community Partnerships
- Management and Fund Procurement
- Staff Development

Individuals with key interests in each area were selected and asked to staff each respective committee. From the inception of the project there was a high degree of congruency between the skills of the committee members and the tasks that were required of them. Throughout the summer of 1997, the intrinsic motivation inherent in the opportunity to build their own future, fueled the committees' efforts and ultimately led to the success of the initiative.

Flowing Wells' Vision for Technology

Guided by articulated core values, the technology team set out first to envision what successful technology implementation should look like. Incorporating the driving themes of each ad hoc committee, the team generated a vision statement that would serve to guide all their future decisions.

Flowing Wells intends to assess, acquire and implement technology designed to enrich instruction and achievement,

and will provide staff and students with the skills and opportunities needed to excel in the 21st century.

Only by clarifying what ultimately is desired can effective task-analysis be undertaken. The committees, as they endeavored to construct their portion of the technology plan, never lost sight of how their work integrated with that of the whole.

Benchmarks of Success

Vision and dreams without links to practical, visible measures of success have often derailed otherwise noble efforts at improving instruction, and ultimately, student achievement. To avoid this, the technology team established benchmarks that would truly reveal the extent to which the written vision was being accomplished.

- Every student will have access to appropriate technology at appropriate levels.
- Every student will have access to computers during and outside of school hours.
- All students and staff will have access to the Internet.
- All students and staff will be able to access information according to individual responsibilities from any location within the district.
- All district functions will be tied together through an effective technology network.
- A coordinated and integrated curriculum will be implemented that will prepare students for the world after graduation.
- An effective, applicable staff development program designed to enrich instruction and achievement will be established.

As the summer and the school year progressed, the technology team kept each other apprised of the progress made on each benchmark. This continued, monthly communication strengthened the integration and support between the ad hoc committees.

Ad Hoc Efforts

Each ad hoc committee faced, at times, daunting challenges, yet careful task-analysis, thoughtful division of labor, and the already described intrinsic motivation provided the opportunity for each committee to succeed. Intrinsic motivation aside, however, the work of some committees called for additional compensation. Core values must be embraced by all parts of a school district, and providing monetary rewards for exceptional leadership and initiative is only right if initiative and leadership are to be expected. The governing board and district superintendents were well-prepared to meet the compensatory need, having already formulated and executed a five-year budgeting plan.

It is a common occurrence in education to expect leadership, initiative, and exceptional performance from individuals provided neither incentive nor opportunity to. In what other occupation does this logical fallacy hold merit? Flowing Wells' decision-makers, in addition to walking their talk of high standards and expectations, enacted that other euphemism for integrity: putting their money where their mouths are.

Each committee, engendered with opportunity, inherent desire for success and respectful compensation, set out assessing the needs of their respective realms of concern.

Curriculum

The curriculum committee, chaired by principal John Black and comprised otherwise entirely of teachers, built the district's K-12 technology curriculum around the fundamental paradigm that computers and communications equipment are tools designed to get important tasks accomplished. Technology should not be an end in and of itself, rather the means to whatever end is called for. Basing instructional guidelines on competencies that clearly define what students at each level will be able to do facilitates a streamlined, integrated K-12 curriculum. Instructional autonomy for individual teachers is preserved by basing competencies on actual skills, not assignments.

Figure 1. K-12 Technology Curricular Outline for Flowing Wells School District

A detailed examination of specific competencies at each level of schooling is beyond the scope of this paper. However, it is important to note that students' mastery of the software and skills taught is assessed through evaluation of projects done for core-curricular content areas such as language arts, math, science, and social studies. By assessing student applications of content taught, Flowing Wells adheres to its core values and the principle that technology is intended to facilitate accomplishment.

Business and Community Partnerships

For five years the technological needs of the district were identified and communicated to the community of Flowing Wells. This continual communication helped secure funding well in advance of the initiative's implementation. Flowing Wells, however, is not a wealthy district, its

median household income is only $14,580. The majority of families in the district rent, and increases in property taxes due to bond and override efforts are laid squarely on the shoulders of those who do not own the land being taxed.

Typical technology procurements occur in bursts, with huge sums of money being raised and spent every five or ten years. There is no coincidence that procurements tend to follow five or ten year bond cycles. School districts in Arizona, despite the Supreme Court deeming the current capital outlay laws unconstitutional, are forced to rely on increasing the tax burden on the families of the children they serve. The business and community partnerships committee sought to find a more creative solution.

Leasing. Instead of purchasing, at enormous expense, hundreds of computers that will be well on their way to obsolescence in five years, the committee investigated the option of leasing technology. Through the local affiliate of Microage, all legal and financial considerations were explored and documented. Though more expensive than purchasing in interim years, leasing avoids having to drop bond issues every five years on communities which cannot afford them. Additionally, the service provided by Dell Computers and Microage ensures the quality of the product and protects the district from the possibility of wide-spread equipment failures (as occurs frequently when districts low-bid for hardware). The lease is up for renewal every three years, allowing the district to upgrade to new technology as it's made available. The steady fund requirements mandated by leasing facilitate long-term budgeting and expansion planning.

Management and Fund Procurement

Lead by Dr. John Pedicone, the management committee assessed the communication needs of the district in addition to aggressively searching for alternative funding sources such as grants and corporate donations. The committee analyzed the needs of three distinct, yet systemically-tied realms.

Figure 2. Technology Needs Assessment Diagram

With the needs assessments in place for each major sphere of concern, the management committee began structuring future budgeting strategies around the hardware, software, and staff development necessary to achieve the district's goals. This 1/3, 1/3, 1/3 principle ensures that hardware, software and training capabilities will remain aligned and the district's spending balanced.

Connectivity. Quality communication between all ten sites in the district, as well as the vision to fully incorporate the Internet in instruction, mandated the acquisition and installation of T-1 lines throughout the district. Additionally, through strategic integration of wide and limited area networks, the district intends to connect all classrooms and libraries to communication nexus points, facilitating exchange of information. These connections form the skeletal structure of any effective technology plan. A detailed, two-year plan was outlined to insure success of the connectivity component of the initiative.

Many technology plans develop from the top down, bringing in expensive computers and software before establishing the necessary infrastructure that will maintain and support instructional efforts. Flowing Wells, by installing the hard-wiring first, and ensuring its quality and effectiveness, will establish a healthy foundation in which future technologies can be integrated.

The management committee secured $50,000 through a federal grant. The grant included a proviso that mandated installation of communication lines (which the grant is intended to be used for) by the end of the year. Success in this endeavor will allow the district to pursue $100,000 in additional funds. The E-Rate is a communication-equipment grant drawn from the $2.25 billion telecommunications companies across the country have been required to provide public education. The funds are federally allocated based upon a district's percentage of students on free or reduced lunches. Districts like Flowing Wells can benefit greatly from the E-Rate, and build a strong foundation further grants can supplement. The E-Rate funding will enable Flowing Wells to realize their connectivity goals by the end of December, 1998.

Administrative Software. A district wired together with LAN and WAN networks can greatly increase the effectiveness of its inter-district communication. Attendance, discipline and other records can be maintained, updated and accessed with ease from any location within the district. Streamlining record keeping empowers teachers and administrators to better serve their students by freeing up planning time from administrative and disciplinary paperwork. The committee researched and evaluated a variety of administrative software, deciding upon CIMS and SASSI. CIMS and SASSI are designed to keep records on attendance and provide seamless communication with a variety of state institutions. Incorporation of this software will enable Flowing Wells to have a K-12 integrated attendance system in place for the 1998-1999 school year.

Staff Development

Effective implementation of technology mandates its use and application. Often, however, fancy toys are placed on teacher's desks with the expectation, without any training provided, that the equipment will be utilized effectively. Susie Heintz, staff development coordinator of Flowing Wells, assembled a committee with the articulated goal of guaranteeing quick and effective technology implementation in the classroom. The technology team early on decided upon the purchase of Windows and Microsoft compatible equipment and software. This decision was not made lightly, rather reflecting upon the core values of the district and the prevalence of IBM and Microsoft applications in the work force, it was deemed in the best interests of the students to move away from Macintosh products.

Technology Vanguard. The prior year, with a core group of teachers, some initial training was performed in existing labs. These teachers, known as the Technology Vanguard Team, formed the pool from which the writing and training teams were assembled.

Training Modules. Selected members of the Vanguard Team spent the summer of 1997 writing training modules for Microsoft Windows and Office, specifically Word, PowerPoint and Publisher. Supplementing these core applications, were modules developed for Hyperstudio and Grade Machine +. The modules followed an exacting format and were compiled into a master staff-development handbook. Each module was framed around conceptual elements inherent in each program. These concepts were then broken down into specific objectives, and step-by-step instructions. Each module created the opportunity for participants to make a product for immediate use in their class. Teachers and support personnel walked away from each training seminar with usable material, and as labs were installed month by month across the district, opportunities to continue applying their skills. The modules are of the highest quality, complete with anticipatory sets, guided and individual practice sections, and interactive, step-by-step closures.

Inservices. The modules were structured to cater to a specific level of participant competency. The Windows training, for example, occurred early in the year while the Hyperstudio module was held in February 1998, and required passing a pre-test to attend. The Vanguard trainers attended design review nights held by the staff development coordinator and the writer of the module being examined. The most critical elements of each module were stressed and teaching strategies discussed and refined.

Vanguard members and participants received additional pay for writing, teaching, and attending modules and inservices. Again, this in keeping with the district's core values. The sessions were held in the evenings at a variety of different schools.

Conclusion: An Analysis of Successful Leadership

The Flowing Wells Technology Initiative modeled the Delphi Technique: a leadership strategy that is empowering rather than directive. The district has been aware of the need for improvement in the realm of technology for two years, and this need has been effectively communicated throughout the staff and the community. This legitimacy engendered by open communication, fostered collaboration between district and school administrators, teachers, community leaders, and parents. An appropriate tempo for change was set early on. The big spending push came after a successful override had brought salary comparability to the teachers in the district. Staff development and hardware installation occurred concurrently, well-funded and budgeted early on in the process.

Patience and Problem Solving

Problems were identified, defined and task-analyzed by committees staffed by committed, effective personnel. Realms of concern were identified and systemically examined for inter-relationships and cause-effect scenarios. The team remained focused on the core values of the district and established clear vision and intent allowing success to measured and tracked.

Continuous Improvement

Intense and continued evaluation of each component of the plan lay ahead for Flowing Wells. Each phase in the change process is examined and refined if found wanting. Serious efforts will be paid to the continued development of curriculum that focuses on application. The curriculum instituted at the Junior High is an example of the competency-based, application-oriented approach to technology and technology training the district is looking for. Over time, as kids grow more fluent in the use of computers, the competencies and the levels at which they are mastered will have to be analyzed and adjusted. Continuous improvement, driven by relevancy, is the lens district administrators are using to ensure student achievement.

Final Take

Thomas Edison, at the turn of the century predicted the radio would make schools obsolete by the 1920s. B.F. Skinner, as the Cold War rolled forward, thought television would do in public education and the need for teachers. Now computer, electronic and distance learning champions are heralding our end as well. Dr. Phil Corkill, superintendent of Flowing Wells, however, notes, "What makes a difference will be a teacher, exquisitely trained, who cares about the kids. Our money should go not only to provide our kids technology, but to our teachers, letting them know they're our most vital resource."

Figure 3. Evaluative Realms for Continued Improvement

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Inclusion and Technology: A Marriage of Convenience for Educational Leaders

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Foreign countries have for years recognized the significance of alliances between nations through a prearranged betrothal. The result: a collective merging of assets serving to fortify the position of each to embark upon further vistas of achievement and to provide a combined force with which to reckon from an invading enemy, if threatened. The forging of an alliance between inclusion and technology represents such a union—a marriage of convenience for educational leaders.

The computer represents the ambassador of public relations—a virtual monolith, designed as a mechanism of cooperation between children with and without special needs. Inclusive education, the elimination of special education as a separate classroom in isolation from the mainstream of the education process, poses a significant challenge to educational leaders of the 21st century. A comprehensive system of education—the total integration of students with special needs in the regular classroom—transverses the mere embracing of the concept of inclusion.

Thinking Differently

Special education was developed over a century ago to meet the unique instructional needs of students considered to be exceptional or special. Since that time, essentially two systems of education have emerged- special and regular education.

A change of thinking in the belief that a dichotomy of practices is mandatory to address the learning needs of students has been slow and arduous. Teaching strategies and practices that enrich the learning environment are advantageous, not only to a few, such as, students with attention deficits or orthopedic impairments, but rather serve to positively impact the collective whole—the entire classroom of students.

Ideally, education has the potential to be the great equalizer. An environment that cultivates solidarity necessitates the incorporation of teaching methodologies in an integrated setting that bridge the regular special educational categories. If schools are to become the cornerstones of progress, then it is imperative for educational leaders to engage teachers in the continued improvement of professional skills regarding the incorporation of technology into the classroom.

Educational leaders must provide all students, including students with special needs, with access to the same opportunities for a quality education. The engagement of the teaching force in activities that promote the continuing acquisition of current knowledge applicable to the next millennium is crucial.

Serving as Catalysts for Change

Leaders of the next generation need to commit teachers to acquiring a repertoire of new teaching practices that weave technology into the curriculum—all within heterogeneous groupings of students. It will no longer suffice for leaders in educational environments of the 21st century to be "guardians of the status quo," knowledgeable of only the generic, traditional content and process of educational pedagogy and traditional leadership. Rather, the role of the educational leader as a catalyst for change is evolving with the same rapidity as the vision of the teacher as the facilitator of learning.

First and foremost, leaders need to connect diverse collections of students; instructional technology provides the foundation for such an amalgamation. Future leaders must foster the incorporation of technology into the inclusive classroom to maximize the learning process for all students. Administrators need to invest time and energy in activities that range from establishing fundraising partnerships with businesses for the purchase of computers, to encouraging parents to gain new computer skills, to assisting teachers in adapting performance standards in instructional technology.

Identifying Relevant Issues

A prevalent issue that emerges for educational leaders in the use of instructional technology concerns access and equity. Gilster (1997) emphasized that equity within the United States and global equity are of great concern. Although some wealthy suburban areas have high-tech environments, schools located in poverty areas and those

located in other parts of the world are denied access to computers.

Cost benefit versus cost efficiency in improving educational outcomes is also a consideration for administrators. Some school budgets are delineated to allow for purchases of new computers and the associated technologies—Internet connections and multimedia capabilities. Yet, the fiscal resources necessary for supplying students with high-performance computing and communications technology varies (Coley et al., 1997).

Leaders in educational environments must be cautious not to envision the computer as a panacea for all educational woes for all populations-regular and special education alike. To perpetuate the perception that educational deficits are remedied and gaps in learning circumvented with nothing more than proximity to the computer is erroneous; no truth is less self evident. A gamma ray-like epiphany does not happen; students do not become transformed by some osmosmotic process that passes from the computer screen to the cerebrum of the student.

Increases in student achievement require the initiation and nurturing of systematic reform. Change requires participation in word and deed of all constituents of the educational process— students, teachers and administrators. Innovations need to embody the enhancement of the focus on professional development, pedagogy, assessment, curricula and especially leadership.

Seizing the Opportunity

The momentum, generated by the clarion call to action for educational reform, must be seized as an opportunity for educational leaders to promote an agenda for change—one that stresses unprecedented spending on computers and associated technologies. Educational leaders must prioritize computer acquisition, installation and replacement as crucial to the success of an educational organization.

Implementing change in educational organizations is particularly difficult and historically slow. Educational leaders must beware of modern Ludites i.e., individuals who abhor technology. One need not look further than the rationale for linear-row seating arrangements in classrooms to truly understand the inertia representative of schools. Beginning with the Industrial Revolution and continuing today, small aliquots of space in singular, designated patterns were designed to mimic the atmosphere of the factory and, most importantly, to prepare students for their jobs as future factory workers.

Many educational leaders are approaching the technology movement with evangelistic-like enthusiasm, proselytizing teachers, parents, school board members and communities into the flock of believers. In creating an environment for a change to a more technologically-focused delivery of educational services, educational leaders should exercise caution in avoiding fallacious thinking where technology is perceived as a "magic potion" in which one dose works well and several doses work even better. Unique applications of technology, implemented by technologically competent teachers, can serve to improve student achievement and prepare all students for employment in the technologically-focused, futuristic world of the next generation.

Educational leaders need to focus on the role of the computer in providing vocational skills and in easing the transition from school to work. Students with special needs are sometimes seen as non contributing members of our society unable to attain gainful employment. The computer helps all students assess their abilities and talents and establishes a match with potential opportunities.

Today's students are living in electronically-immersed realities in which technology can make learning easier and certainly more fun. School administrators need to: support initiatives that foster innovative uses of technology in the classroom; accept the onus of responsibility as the major change agent of schools; and, provide the resources for the acquisition of the new tools for learning.

Visualizing for Tomorrow

A mind set is entrenched: technology is beneficial to improving student outcomes. What is not addressed concerns a value-added dimension: technology is advantageous to students with special needs in a variety of ways, including higher academic performance and increased interaction with peers.

The vision of inclusion is one in which students, regular and those with special needs, interact in a technologically-supportive environment. Significant changes in instructional practices must occur if students with special needs are going to achieve in a regular classroom at levels equal to or higher than when they were in self-contained, special education classes.

Educational leaders must visualize instructional technology as a modem of communication with the potential to serve as a metaphorical olive branch for students with and those without special needs, and for teachers supportive of inclusion and those in favor of exclusion. Students designated as low, average, or high-achieving can benefit from the application of technology in the classroom.

A major critique of inclusion by veteran teachers concerns the perceived deleterious effect an inclusive setting will have on the learning process for regular education students in the traditional classroom. Minimization of negativity concerning the inclusive process stresses the education of pre-service and in-service teachers in strategies that include: the development of an expertise in the learning styles of students and the accompanying technology that promotes the uniqueness of the learning process for each student. Fostering a classroom climate that not only tolerates but appreciates individual difference is imperative.

The classroom of tomorrow will be vastly different from the classroom of the present. Efforts directed at conquering the challenges involved in integrating technology into the

curricula continue to divulge new avenues of learning worthy of exploration by educational leaders. According to (Bruce & Levin, in press) the range of learning experiences for students is dramatically increased and enhanced with interactive, multimedia technology in which text, voice, music, graphics, photos, animation and video provide for active, focused learning.

Innovative projects and resources using a variety of technologies from electronic networks, integrated media, and problem-solving applications support the development of higher-order thinking and provide excellent opportunities for teachers to gain new knowledge and skills. Such programs and projects include: The National Aeronautics and Space Administration On-line Resources for Educators, including The GLOBE Program-Global Learning Observations to Benefit The Environment, NASA Spacelink, NASA Teacher Resource Center Network and NASA's Central Operation of Resources for Educators(CORE).

Leaders of the 21st century must broker the relationship of inclusion and technology as a marriage of convenience. The computer must be personified as a diplomat of public service—a non-threatening purveyor of knowledge that assists educational leaders of the future with the ultimate challenge: the delivery of educational services to academically, behaviorally and culturally diverse students.

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Organizational Culture and the Classroom Integration of Computer-Mediated Communications

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Two themes currently receiving considerable attention in discussions of education are technology and reform. Studies are linking the two, some of them with great hope for the future (Sandholtz et al. 1997), and others with a somewhat more concerned view (Means, 1994). The impact of online technology, when used as computer-mediated communication (CMC), on schools will stimulate changes in teaching practice, and in student learning (Heflich, 1996). However, it is well known that schools are social organizations with identifiable and distinct cultures (Sarason, 1991). Cultural change is problematic, depending in large part on factors that are neither fixed, nor linear (Fullan, 1993). This study attempts to clarify the relationship between CMC and school culture, hopefully leading to a better understanding of what will be needed if the promise of technology in educational reform is to be realized.

CMC in education

The presence of CMC in schools is growing rapidly. According to Heaviside, (1996) half of all public schools currently have access to the Internet, and 74% of those not currently connected plan to do so in the future. Even so, only 9% of all instructional rooms now have direct access to the Internet. Among all U.S. public schools, 85% have access to some sort of local or wide area computer network. Public schools have an average 72 computers, however only 14% of all computers in schools have direct access to computer networks (Heaviside, 1996).

Great claims have been made on behalf of the benefits of CMC for teaching and learning. Wilson (1995) reports strong positive effects for the use of technology in the classroom and its impact on teaching methods, teacher attitudes, student achievement, and student attitudes. Students participating in CMC-based learning circles dedicated to student writing demonstrated significant gains in writing ability. (Riel, 1994). A 1995 Office of Technology Assessment (OTA) study distinguishes between teacher-centered instruction and student-centered instruction. Teacher-centered instructors tend to use computer technology in a didactic manner, emphasizing its use to reinforce skills with drill and practice software. Student-centered instructors use computer technology in a more collaborative fashion and are more enthusiastic about its use because it supports their style of teaching (U.S. Congress, Office of Technology Assessment, 1995).

The changing role of teachers that emerges from the use of CMC is reiterated in the literature on teacher education and professional development. Teacher education and ongoing professional development opportunities are now being offered online (Schrum, 1992). The use of online computer conferencing has been used to affect the moral development of preservice teachers by providing them with a venue for reflective discussion (Harrington, 1992). CMC expands teachers' boundaries, allowing them contact with colleagues, school offices, experts in various fields, and parents (U.S. Congress, Office of Technology Assessment, 1995). Direct connections that teachers make through the use of CMC help overcome the barriers to professional growth that are the byproducts of teaching in isolation (Riel, 1993).

Technology and school culture: The problem of change

Changes in teaching and learning have been subsumed into the general topic of school restructuring. In order for restructuring to succeed, it must address the core cultural relationship between the teacher and the student (Fullan, 1993). Implicit is the idea that schools in much of the country are structurally aligned in ways that inhibit change. The use of time, the requirements of state mandated curricula, and the nature of assessment limit the ability of technology to effect changes in teaching.

Cuban (1986) argues that computers, like other machines before them, are used by teachers in ways that supplement, rather than change, their practice. The fact that the environment limits changes in teacher practice is particularly true when considering the use of technology. Computer technology although relatively inexpensive, is a major investment for schools. Many districts have inadequate access to computers, modems and even telephone lines (Honey & McMillan, 1994). School districts operate

in a public arena with different priorities for making decisions about how to use technology. The changes in teaching practice envisioned by many as a by-product of CMC are limited by the institutional and social barriers to change in many schools and districts (Winn & Coleman, 1989).

Barriers to the full adoption of CMC are a significant topic in recent studies. Heaviside (1996) summarizes the problem as a lack of funding and inadequate access to online resources. The OTA report (1995) is more specific. Although schools are investing heavily in hardware and software, they are not exhibiting the same concern with how technology will be used. There is a lack of adequate training for teachers. Furthermore, there is a lack of on-site technical and curricular support for teachers in the use of technology in the classroom. Access is an issue as well. Most online computers are located in offices or laboratories. Teachers need to make special, often difficult arrangements for their classes to use the machines. Finally, the age of computers in schools limits their ability to be of much use in the curriculum. Although the U.S. leads the world in the number of computers in schools, it falls behind in the number of modern computers available (U. S. Congress, Office of Technology Assessment, 1995).

Introducing any educational innovation is a process that needs to confront the culture of school (Sarason, 1991). Fullan (1993) has aptly described the process of educational change as a voyage that is non-linear and full of problems. Educational change will only succeed if the relationship between the teacher and the learner is at the forefront. Fullan (1993) has argued that change needs to involve the effort and support of both teachers and administrators in order to succeed. Furthermore, teachers must recognize and understand the benefits that will accrue to them if they are to abandon their tried and true educational practices for new ones (Sandholtz, 1997). The OTA report (1995) advises school districts to invest as heavily in human resources as it does in hardware and software. It advocates a technology plan in which training and support occupy one third of the technology budget.

Summary

Although the real and potential benefits for the classroom use of CMC are evident, it's adoption by schools is limited (Heaviside, 1996). One apparent reason for the discrepancy between use and benefit is the fact that CMC is relatively new. In many cases, the discrepancy is a factor of the culture of school and the difficulty of change. A number of studies (Heaviside, 1996; U. S. Congress, Office of Technology Assessment, 1995; Honey & McMillan, 1994; Wilson, 1995) identify funding, access, human resource development, and the implementation process as barriers to change. Fullan (1993) argues that all of these can better be subsumed into the core concept of school culture.

Method

Online interviews conducted as a series of electronic mail exchanges were the primary means of investigation in this study. The asynchronous nature of network communications lends itself to worldwide discourse. Practitioners with access to CMC have the ability to exchange ideas and information almost anywhere in the world.

Sampling was conducted by posting notices on a number of discussion groups concerned with education. The sample was composed of twenty-five educators representing schools in 16 states and 6 countries. Some schools have already adopted CMC, and are experimenting with its use; and others are in the process of adopting CMC. Fifteen of the schools are elementary; ten are secondary or K-12 schools.

An interview protocol was developed for use in e-mail exchange. It allowed for in-depth exploration of the implementation and integration of CMC into the curriculum. It included questions concerning the subject's teaching practice and the support CMC receives from other members of the school community. Recognition that each school's experience with CMC is unique favored the use of an unstructured interview rather than an online survey.

Data analysis was conducted according to the guidelines of the Constant Comparative Method (CCM), first described by Glaser and Strauss (1967). The goal of CCM is the emergence of theory from data, derived through repeated review of the data, each time examining it in order to locate common thematic content.

Interpretive validity of the data (Altheide & Johnson, 1994), was established by visiting a number of the sites to develop a visual sense of the school, the people, and the work being done there, and by having subjects review the interview transcripts to determine if they were being correctly represented. The review of transcripts was completed via electronic mail.

Results

Analysis of the interviews led to the construction of themes that represent the ideas, beliefs and practices of the study participants. They include access, a concern for the availability of technology and its ease of use. Themes concerned with school culture are climate, the atmosphere in which the use of CMC transpires, the role of the school administration, and the effect that the implementation of CMC in the school has upon its subsequent use.

Access

The availability of technology in a school has typically been the measure of its use (U.S. Congress, Office of Technology Assessment, 1995). However, the availability of online technology alone does not determine the use to which it is put. A new, broader concept of access is used to distinguish between those schools in which CMC is used effectively, and those in which it is not. Access encom-

passes not only the availability of computers, but also their location and type, the presence of modems and phone lines, as well as any limitations placed on student and teacher use. As such, it addresses a more significant distinction that divides the schools in this sample: the ease with which teachers and students can use CMC.

The schools represented in this study differ in the manner and extent to which CMC pervades the school. High access schools are those in which the use of online computer technology is fully integrated into the curriculum. Local area networks (LAN), with stations in each classroom, offer direct in-school communications capability and access to electronic mail and the World Wide Web (WWW). Teachers in high access schools use online resources with their students. Students have the ability to use CMC and the space needed to work on projects , which originate online. All of this takes place within a school culture that encourages and supports the use of CMC. Low access schools are not connected by a LAN and CMC is available from a single site, which teachers need to schedule in advance. Use of the accessible site may be limited to a few hours a week, or have other limitations such as the absence of good workspace. Student access to CMC is restricted in these schools. A culture of support for the use of online computer resources in the classroom is missing.

The underlying question concerning the classroom-based, curricular use of online computer technology is one of change. The process of change begins with a decision to invest in online technology, leads to the ongoing process of planning, purchasing and installing new equipment, proceeds to training and staff development for the professional staff, and culminates in ongoing technical and curricular support for the use of CMC in the classroom. The most highly accessible schools represented in this study approximate this process. Most others are somewhere in the process, with the least accessible schools just beginning the administrative decision-making process.

Climate

A positive school climate is one in which interactions among students, teachers, parents, and administrators are supportive and challenging. Some subjects speak of the respect that underlies all interactions, the level of collaboration and communication among school staff, and the importance of student involvement in their own learning.

Administrators in schools with a positive climate take staff wants and desires into consideration when developing the school schedule or otherwise organizing school activities.

The climate is one in which teachers work together and enjoy spending time with one another, enabling learning to be viewed as something in which individuals become more personally involved.

In contrast, a negative school climate is described as being devoid of support and collaboration. Teachers speak of being isolated from their peers, and lacking coordination and support. Teachers perceive their students as intellectually lazy and the cause of disciplinary problems. Because completion of the curriculum is paramount, innovations are met with suspicion. Although administrators talk of support, they offer little.

Another aspect of climate is the role of parents as part of the larger school community. Most high access schools have an active group of parents, who participate in PTA, serve on school committees, and participate in fund raising activities.

School climate is a significant factor affecting the success of CMC in schools. Schools with a positive climate are characterized as a place where thought is given to the way adults interact with students, and with each other. In contrast, negative school climates are places where relationships among administrators, teachers and students are obstacles to be overcome.

Administration

The attitudes, ideas and leadership styles of building and district administrators affect school culture by the level and type of communication they engender, as well as the support felt by individuals. The administrator is a significant actor in all aspects of the process of implementing CMC into the classroom. His/her leadership and active support of the technology plan may make a difference between success and failure.

The importance of the principal in teacher adaptation to the use of technology in the classroom is evident. Effective administrators provide a level of professional leadership that empowers their staff. Good administrators are supportive and flexible, accommodating the needs of their teachers in a number of ways. Administrators can devote the resources needed to replicate successful programs in schools throughout the district. They can develop and support partnerships between schools and universities or corporations to stimulate the use of online computer technology in the classroom.

School administrators are significant in the culture of an individual school. Their leadership and active support of the use of CMC can ensure that it will be uniformly accessible to teachers and students. A lack of administrative leadership and support becomes a barrier to school change that is difficult to overcome. It limits professional growth by teachers and reinforces a hierarchical structure of school.

Implementation

Few things foreshadow the success of CMC in the classroom quite as much as the implementation process. Implementation is a complex phenomenon that includes planning and decision-making. It encompasses not only the structural elements of wiring and equipment, but also the socio-cultural elements that support teacher adaptation to change.

The decision to bring CMC into a school typically involves planning by a committee that makes recommendations to the staff and principal. Sometimes the committee has help from an outside agent such as a university or corporation, which can help with finances, equipment and technical assistance. Successful planning efforts become part of the school culture, often stimulated by the district office or the principal.

When planning focuses on equipment and software, the element of professional development may be neglected. The effective use of CMC as a vehicle for enacting the curriculum depends on the adaptation of teachers to the use of technology in the classroom. Teacher appropriation of classroom technology is the result of the individual's ability to change, not simply the act of placing computer technology in the classroom. The OTA Study (1995) finds that extensive staff development is a necessary prerequisite for teachers' successful adaptation to computer technology.

Subjects working in schools which have a high degree of access are uniformly part of a culture in which training and professional development are the norm.

Some low access schools severely limit the amount of time teachers have for learning about technology, or adapting it to classroom use. Money for new equipment or training is difficult to find. School district leadership is not supportive, or even anti-technology, and has a difficult time conceptualizing change.

Those who advocate for CMC in low access schools often have to confront teachers' fears about changes that may result from its introduction into the school.

The implementation process can significantly affect the rate and quality of the adaptation of the staff to the use of online computer technology in the classroom. Planning and decision-making can help build staff interest in the use of online computer technology in the schools. Finally, the staff's adaptation to the use of CMC and their comfort with the medium is enhanced by an ongoing culture of staff development that focuses on teachers' use of CMC in a curricular context.

Conclusion: The Relationship of Culture to Access

A positive school culture allows a high degree of access to CMC to develop. The aspects of a positive school culture include trust and collaboration among the professional staff, a commitment to professional development, and a respect for students as individual learners and administrative encouragement and support. Together, these factors help make the difficult transition to CMC easier. They also allow the spirit of experimentation and exploration, so necessary for successful online teaching and learning, to develop.

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Educational Reform: Ten Ideas for Change, Plus or Minus Two

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It is the intent of this paper to foster discussion toward new ways of viewing our educational system by effecting change via small, initial adjustments. These initial changes have the potential to change our present, outdated, Industrial Age school system to a modern, Information Age system, where the emphasis is on learning and not teaching.

Since the publication of A Nation at Risk (1983), both educators and non-educators have proposed solutions to the nation's educational problems. These solutions range from a total rebuilding of our educational system to numerous band-aid approaches. The band-aid approach yields little and tends to perpetuate the status quo. Those in power have nothing to gain from a reformation. It is axiomatic that what bureaucracies do best is to maintain themselves. Thus, for the past one hundred years we have seen little change in an educational system built to sustain an industrial economy.

It can be argued that the only way for systemic change to occur is through a total extirpation of the present, state-centralized model and construction of a new, decentralized system built for an information economy. In fact, there are some convincing arguments for this. (Perelman, 1994; Wilson & Daviss 1994; Gerstner 1995; and Lieberman 1995). Perelman even contends that our educational system will collapse in a few years because of its own internal, bureaucratic, centralized controlled model, in much the same way as the Soviet Union collapsed - almost overnight. While this total collapse remains to be seen, it is quite evident that major changes, which address the root causes of the present system's failures, are needed.

K-12 education is, Constitutionally, left to the individual states. While the federal government can set national goals, guidelines, and, in some cases mandate monumental laws, no one is seriously arguing for federal control of our school system. Control of individual school systems will remain within the province of the individual states. The problem of reform is for the states, both individually and collectively, to solve.

Thus, we present a number of fundamental ideas that could be implemented by states, either individually or collectively, to change our current educational systems into Information Age system. Taking our cue from Chaos Theory, which states that all systems have a sensitive dependence upon initial conditions, we suggest a series of small conceptual variations to our present educational system that might, in turn, result in large substantive changes.

Idea 1: Change the endorsement of teachers from certification to licensing

As it now stands, teachers are sanctioned to teach by the state through a process of certification. Prospective teachers take courses specified by the state, from universities accredited by an agency, usually determined by the state. Before becoming a full-time teacher, an individual must receive certification in one or more subject matters from the state. Although there are a few exceptions, this is the rule that operates in most states. It is the primary rule that controls the system.

The university that one attends generally has little choice in determining what courses a prospective teacher studies. The state, in essence, determines the amount of time spent in taking courses, the types of courses studied, the content of the courses, and the acceptable performance level to be declared a teacher. The state, not a professional school, determines what it takes to become a teacher.

Consider how physicians, lawyers, and other professionals are sanctioned by the state. They are not certified, but licensed, to practice their discipline. They obtain this license by taking an examination created by their respective profession and administered by the state. The profession determines the criteria one must meet to practice.

To become a doctor or lawyer, an individual attends a professional law or medical school. The school determines the course content, and the time spent learning the profession. Graduation from the school does not ensure that the graduate will practice. It is up to the profession as a whole to determine that. The role of the state is to administer an examination designed by the profession. There is no Department of Medicine nor a Department of Law to specify what a doctor or lawyer should know. In other words, the

state serves as a regulatory agent only and not as the specifying body of content, as is done in education.

Teachers should be licensed and not certified. Furthermore, the state should get out of the business of dictating what skills, knowledge or information a teacher should possess. The consequences of such a change would range far and deep into our educational system. Removing from the state the power to dictate the specifics of curriculum, and other matters to the education profession, would result in colleges of education becoming more proactive and competitive in their preparation of teachers. Certainly, the standards of the profession would increase just from the competition among professional schools of education. The entire curriculum of education, now dictated by the state, would change. Just as in medical schools, specialties would increase, internships would be longer, residencies would arise and teachers would be much more expert in their discipline.

Licensing would give teachers an incentive to become educational entrepreneurs. They might form groups with other licensed teachers to operate charter schools. Supply and demand would come into play. Public and private schools would vie for these new kinds of teachers. Parents would demand that the best teachers are hired and the worst fired. Licensing would encourage the free enterprise system to operate. Vouchers of some sort might gain acceptance. The change from certification to licensing would have a domino effect throughout the system. No one can tell the eventual results. However, we do know that licensing, not certification by the state, is the model for the Information Age.

Idea 2: Change the school system from a Time Constant – Achievement Variable status to an Achievement Constant – Time Variable status

Our present school system embraces a model that keeps the time constant and varies the achievement level. We require learners to spend a pre-specified amount of time in the classroom, but allow them to exit with different levels of competency. This model was designed and needed for an industrial economy. School usually lasts 180 days per year. Learners spend six-eight hours in school per day and classes are based upon a strict time allotment of minutes per hour. In an industrial economy, time is the major factor. Workers must be on time, they must work a specific number of hours, and their reward is based upon the time spent at the workplace. Thus, schools were designed and operated to prepare learners to function in this time oriented paradigm. Although some learners accomplished more or less than other learners, all were equally conditioned to punch the clock.

For an industrial economy, this is a good model. For an information economy, it is a bad model. We suggest a simple reversal of the situation currently in place. Moving to an achievement constant – time variable model would change the way schools operate, take into account the different abilities of learners, and conform to contemporary learning theories. For example, schools could be open 24hours/day 365 days/year. Learners would progress through the systems at different rates. They would enter and exit at different times, and they all could accomplish an acceptable level of achievement. Many different programs could be offered at the same time to accommodate the distinct learning styles and life goals of the learners. The worth of a school would be based upon how well it educated its learners as opposed to how many attend each day. The reverberations through our entire society would be enormous.

Idea 3: Recognize that it is the individual who learns, and not the group

It is interesting to note that most measurements about the accomplishment of schools, school districts, and state education requirements are based upon the assessment of the group and not the individual. This is what we call the statistic of the average. We also call it a fatal flaw in education.

Here is a trivial example. We call it Method A vs. Method B. Assume that we want to test the effectiveness of a new instructional method, say, computer assisted instruction (CAI). We set up a comparison experiment between CAI (Method A) and the traditional classroom method of Instruction (Method B). After completion of the experiment, the researchers compile the mean scores and variability measurements of each group, and then use a simple test statistic to determine if a real difference in achievement exists between the two groups. Let us say that the mean score of the CAI group was significantly higher than the traditional group. Based upon this data, the researcher concludes that the CAI instruction is superior to traditional instruction.

However, there is a problem. What we have done is to measure the group's performance, but in the process, we lost all information about the individual. As soon as we calculate the mean score of each group, each individual's achievement is lost. We call this the fatal flaw because, from contemporary learning theory, we know that it is the individual who learns and not the group. In other words, classrooms do not learn, individuals do.

All kinds of decisions in education are made based upon group data. State mandated tests and Goals 2000 are all based upon the statistic of the average — the fatal flaw. Although this statistic of the average works quite well for plants in a pot, pigs in a pen and beans in a barrel, it does not work for learners in a school. What we as educators must address is the learning of the individual. We must design systems that are adaptive to the individual. We must design new assessment procedures for determining individual achievement. We must move away from the statistics of the group and derive new statistics for the individual.

Idea 4: Recognize that the learner is the customer, not the product

Although some would argue that the learner is the product of our educational institutions (Glasser, 1990), others would argue that the learner is the consumer/customer (Harris & Baggett, 1992; Tribus, 1997). Most school systems view the learner as the product. We define the educational system as the seller, education as the product and the learner as the consumer. Although it is possible to identify other consumers of the schools' product, the primary consumer remains the learner.

In addition, we must recognize that our product is education or more specifically information and knowledge. Thus, it is imperative that educators continuously try to improve the product for the satisfaction of the consumer. Given this, then why is it that we in education blame (fail) the consumer when our product fails? Should we not review our product and try to improve it? Of course, but as present educational systems are configured this is not possible until we recognize who is the consumer and what is our product.

Idea 5: Adopt the Deming system of profound knowledge

Most educators know of W. Edwards Deming and his fourteen points of Total Quality Management (TQM). These points are derived from his system of profound knowledge (Deming, 1997).

Deming provides not only a philosophy, but also a process for success. Many educators use the word quality with little or no understanding of its true meaning. Most of us fail to recognize that quality is a process, and that the pursuit of quality is never ending. We contend that if educators concentrate on quality, they can completely restructure the way that administrators lead, teachers teach and learners learn. Combined with technology, Deming's philosophy is a powerful tool for the design of Quality Schools (Cafolla & Kauffman, 1993).

Idea 6: Change funding method of schools. Funding should go directly to schools, be related to the satisfaction of the customer and established by the quality of the product

The manner of funding schools via school districts must change to the direct funding of the schools themselves. If a school is successful, the money will follow. Alternative ways to fund schools should be examined. If you change the fundamental structure of the system via the ideas presented herein, new avenues of funds will open. Most certainly, a voucher system of some sort will be implemented. This places the money in the hands of the consumer and not the bureaucracies that manage and determine the system's policies. If vouchers are given directly to individual schools or teachers by the consumer, new school systems, such as charter schools and other models will emerge. Our school system should be placed under the free enterprise umbrella. Schools that work will prosper, those that do not will fail.

Idea 7: Adopt ideas from the new sciences.

Chaos theory, cognitive science, complexity, artificial life, artificial intelligence and criticality are but a few of the new sciences that offer a deeper view into how the human mind works and how humans learn (Bailey, 1996; Dennett, 1996; Coveney & Highfield, 1995; Holland, 1995; Levy, 1992; Kauffman, 1995). For example, Resnick (1997) sets forth a theory of learning called Contructionism that emphasizes two different views of Constructivism.

Other ideas, including emergent systems, simple rules that result in complex behavior, and an evolutionary process that continually adjusts the brain to the surrounding environment by maintaining the brain in a state of criticality are all ideas that relate to learning. (Bak 1996). As educators who have held to the discredited ideas of behaviorism much too long (Gardner, 1987), we must reorient our methods, and revise educational content to fit into an Information Age, and thereby transform teacher training into teacher education. .

Idea 8: Emphasize creativity

There is a critical need for a better balance in training divergent thinking, as compared to convergent thinking. Teachers can cultivate learning experiences by providing creative environments that emphasize the comprehension of facts over their memorization. A recent study conducted by Hamza (1996) revealed several factors that seem to promote a creative learning environment. Some of these are the teacher's knowledge, character traits, teaching style, passion and attitude toward learners, the learning climate, teacher-learner interaction, and learner attitudes. It is also observed that learners favor creative, open, and non-threatening environments over those governed by authority and conformity. Schools commonly do not reinforce creative thinking nor do they aim to foster creative environments. These deficiencies appear to significantly hinder learners' abilities to become productive workers. (Carr, 1994; Drucker, 1986)

Idea 9: Require that all educational activities be based upon verifiable learning theories

Learning theories, teaching methods, and research are extremely significant sources of ideas for educators at all levels. For example, communication theories can help teachers understand the process of communication between learners and themselves. Systems theories give teachers a better understanding of the working of various systems and their subcomponents. Instructional design theories help teachers build a system of professional expertise for diagnosing learning problems, and prescribing possible solutions. Cognitive learning theories can help educators understand the nature of skilled intellectual performance. (Means, 1994). Theory based learning must be one of the fundamental building blocks of any new educational system.

Idea 10: Use technology in new ways

The computer provides educators with a unique and universal tool. It gives educators the resources to simulate real-life events, investigate the nature of living and non-living entities, perform complex experiments, build new systems, and allow learners to create unique environments and systems from scratch (Papert, 1993). The computer combined with the Internet provides learners with immediate access to the largest amount of information and knowledge ever to be collected in history.

Although distance learning is not a new idea, new models are being designed and used. The Internet and the advances in programming tools for implementing learning models via the World Wide Web provide a unique opportunity for educators to broaden their sphere of influence from the local classroom to the cyberspace classroom. Using sophisticated tutorials, educators can reach the individual learner wherever he/she may be, at any time.

Technology gives us the ability to displace both time and place as the main functional components of traditional schooling systems. The possibilities are endless. Within our imagination, it is not impossible to conceive of the end of the traditional schooling system, when it is recognized by educators, learners, parents and legislators that learning does not necessarily have to occur in a place called school.

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Strategies to Support Effective Distance Education Programs in High Schools

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Distance education, when defined as an educational transaction between a teacher at one location and a learner at another, dates back to late nineteenth century correspondence courses. Today, distance education encompasses a myriad of delivery systems that provide learning opportunities to students of all ages (Moore & Kearsley, 1996).

During the past decade, American high schools began using distance education technologies to offer students courses in math, science, and foreign languages. These courses often use a teacher-facilitator-student model where the teacher is at a remote site and the facilitator and students are in a local classroom (Tushnet, 1994). Teachers and students have always been major components in educational systems, but the classroom facilitator represents a new component. Little is known about roles classroom facilitators play in distance education, how they affect other components in the system, or how they affect system outcomes (Willis, 1992).

This study was initially designed to identify the roles of classroom facilitators and students within the context of a high school distance education course and to examine how those roles affected student performance. However, it quickly became apparent that the school itself played an important part in facilitator and student behavior and achievement. Consequently, the focus broadened to reflect a realm of variables, including school attributes, that influenced distance education in this setting.

Design of the Study

An ethnographic, multiple case study research design was used for this study. Three classrooms from different high schools (South High, Central High, and North High; all fictitious names), each taking the same nationally offered distance education physics course during the 1994-95 school year, participated. The course was delivered live, via satellite. Telephones and a computer keypad system connected the students with the remote teacher. The course design included 30 minutes of instruction and other activities provided by the satellite teacher, as well as a 20 minute off-air period during which the facilitator and students did homework, discussed problems, or did labs.

The research methodology included extensive classroom observation, informal and formal interviews with classroom facilitators and students, and review and analysis of student work products, extant documents and resources used in the course. Each participating physics class was observed daily, in its entirety, for two consecutive units of study. A third unit of study was observed later.

A purposive sampling strategy designed to provide maximum variation was used to select the participants. Case variations included (a) facilitator certification (science, social studies, not certified); (b) facilitator distance education experience; (c) class size; (d) student demographics; (e) match of the school and distance education course bell schedules; (f) number of distance education courses offered by the school; and (g) location of the school (two adjacent states, three school districts).

An inductive constant comparative method was used to analyze the data. Collected data was transcribed, compiled, and coded; and then compared and contrasted to identify patterns and trends. Triangulation of data collection methods and data sources was used to enhance reliability and validity.

School Impact on Facilitator and Student Roles and Performance

The schools in this study had a major effect on facilitators and students. The high school calendar, including student and teacher holidays, and special events scheduling such as pep rallies and assemblies, affected how frequently students missed regularly scheduled distance education classes. This, in turn, affected facilitator roles in terms of planning for students to make up missed coursework. In one school the facilitator just taped the programs and made them available to students; in another the facilitator showed the makeup tape during a later class period; and one facilitator had to plan special make-up periods outside class. Ultimately, student performance was affected by when, and if, classes were made up. This was particularly evident at South High where many school holidays failed to match the distance schedule, and where a number of special activities

disrupted class. In addition, over half the students at South High missed physics once a week for an entire semester as a result of another class. As the South High facilitator noted, "If they miss it and don't make it up, and then they get lost, it's a wipeout. They never catch up." Thus, the school calendar had an adverse effect on student learning in physics if it meant students missed classes to the degree they got behind and couldn't (or didn't) catch up.

The school bell schedule also influenced student and facilitator activities. At North High a German class was scheduled at 9:00 a.m., just as the off-air physics time was beginning. As a result, physics students went to the media center for the off-air segment and the facilitator stayed with the German class. This meant the facilitator could not participate in off-air activities with the physics students, and she felt this was detrimental. During previous years, she had used off-air time to encourage students to call the physics teacher with questions they did not understand, or had encouraged them to do homework together on the chalkboard. These activities allowed students who were having difficulty to get help, either from the physics teacher over the phone, or from the other students in the class. However, the 1994-95 North High physics students were reluctant to call for help unless the facilitator actually placed the call. Due to the scheduling of the 9:00 a.m. German class she was rarely able to do this. Cooperative learning through mutual homework review rarely occurred because students spent the off-air time in the media center visiting with each other rather than doing homework. Students in the media center were also unable to complete lab or other activities that required equipment access. At South High School, the bell schedule split the off-air period into two short segments that tended to be wasted by the students.

School registration procedures had a major impact on North High students in terms of pre-requisite skills. The physics course required Algebra I and II as pre-requisites, but a number of North students were misadvised and did not meet these requirements. As a result, most of the North High students had poor math skills and were unable to perform the algebraic procedures required in physics. Consequently, their acquisition of physics skills suffered. While the facilitator became aware of the algebra deficiencies early in the course, she had no way of providing remediation.

Prior school experiences also affected physics students. North High students had chosen physics because they had heard, from other students or the chemistry teacher, that physics was easier than the alternative chemistry course. So, their expectations were that the course and the work required of them would be easy. While a number of the students at South High perceived that physics was a more difficult science, the amount and kind of work they were used to putting into courses did not prepare them for the effort required by the distance education physics course. Many lacked adequate study skills and discipline. The South High facilitator observed, "I think this class requires more from them than they've been used to. They need to look at physics every night, and they just did not do it." And while all but one South High student met the algebra pre-requisites on paper, most believed that the skills they had acquired in their algebra courses at South High were inadequate.

School drop policies for distance education courses affected some students. None of the three schools allowed students to drop distance education courses after tuition had been paid to the course provider. But, several students at South and North High Schools indicated they would have dropped the course had that been an option, since they were doing so poorly in it. The drop policy may have indirectly contributed to a test retake policy at South High and a lenient homework policy at North. Both policies provided an opportunity for students to improve their grades although the policies did not support student learning. Generally, the South and North High facilitators did whatever they could to help students pass the course since they could not drop it.

Other school responsibilities affected the amount of time the South High facilitator actually spent in the classroom. The South High facilitator was a full-time school administrator, and as a result she periodically missed entire classes for several days or a week due to meetings, workshops, or other school obligations. Since she was an administrator, substitutes were not hired to take her place as facilitator. Missing classes meant she had to catch up on what had been covered in physics, determine what students had or had not done, and then decide how students would make up missed activities. South High students indicated they did not stay on task and found it difficult to pay attention when the facilitator was away, so the regular learning process was always affected when she was absent.

Facilitator Roles and Their Effect on Student Performance

Facilitators at all three schools agreed that their primary focus was on classroom management and climate, but noted they engaged in some planning and instructional tasks. Logistical planning and implementation was a major responsibility. All three duplicated instructional materials developed by the physics teacher and distributed them to the students. They maintained lab equipment and prepared the classrooms for lab activities. They also decided how to accommodate deviations between the school and physics calendars and schedules. The physics teacher delivered most of the instruction, but occasionally the facilitators provided supplemental guidance or feedback as they responded to student questions. The South and North facilitators occasionally answered informational questions directly, but more frequently directed students to other resources such as other students, teachers, or the telephone

tutors. The Central High facilitator had a science background and was able to answer student questions personally. The North and South High facilitators played a major role in gaining (and maintaining) student attention during class and in eliciting student performance during labs and other in-class activities. The Central High students tended to stay on task, paying attention and participating independently, so the Central facilitator rarely had to assume these roles. All three facilitators implemented the testing and student assessment activities planned by the physics teacher. Each facilitator instituted grading policies and procedures that they thought were appropriate for their students and instructional setting. For instance, at South High students were allowed to retake tests for extra credit and at North High students were allowed to turn in homework long after it was due.

All three facilitators assumed classroom management roles, although the North and South facilitators were more active in this area. The Central facilitator reported, and classroom observation confirmed, that Central High students were mature and required little supervision, while the other two facilitators were continuously working to keep South and North High students on task, paying attention, behaving appropriately and participating in classroom activities. At South High the facilitator constantly reminded them to pay attention and participate in class, and she always coached or guided students through labs, since they tended to sit idly without her direct intervention. The students themselves reported that it was difficult to pay attention when the facilitator was absent. At North High the facilitator sat among the students to keep them on task, and frequently interrupted student conversations or other off-task behaviors to get them to focus on physics. Students at North High indicated that they found it hard to concentrate and pay attention and relied on the facilitator to keep them on task.

The facilitators also assumed classroom climate roles, displaying positive attitudes toward the course and instructor, encouraging positive student attitudes and trying to build supporting relationships with and among the students. The South and North High School facilitators tried to work with other teachers in the school to make them aware of special needs or dispensations the physics students required as a result of their participation in the distance education course. In all three schools, facilitators maintained indirect contact with parents through mid-term grading period progress reports. The North High facilitator also maintained direct personal contact with several parents who were concerned about their child's performance in physics. Students at all three schools attributed their positive attitude toward the class to the facilitators' enthusiasm.

Other Factors that Affected Facilitator and Student Roles and Performance

Individual student aptitudes and other academic skills and experiences also affected the physics students and facilitators. At Central High, many of the students had taken physics because they were interested in the subject. The facilitator observed that most of these students were gifted, and that all had a great deal of initiative and self-responsibility. The Central students stayed focused and attentive during class, rarely had trouble grasping concepts, and found the pacing of the physics class to be satisfactory. They had good study habits, recognized the importance of solving homework problems rather than copying answers, and had good test-taking skills. They also took responsibility for making up classes they missed by taking tapes home or viewing them before or after school. Consequently, their academic performance was good, and the facilitator rarely had to intervene or provide direct support for class activities.

This contrasted with the students at South and North High, most of whom were average students with average academic backgrounds. They had more difficulty staying on task and paying attention, inadequately utilized instructional resources, occasionally found the pacing of the course too fast, frequently copied homework answers just to get credit, and employed educated guess strategies when taking tests. They tended to accept less responsibility for their own learning, relying on the facilitator to help them focus or to make sure they did their homework or labs. While some of the students at North High reviewed tapes for classes they missed, only one South High student routinely made up missed classes without direct facilitator intervention. Facilitators at these two schools provided a great deal of support and guidance during class to help students to pay attention and participate in class activities, to actively help them complete assignments such as labs, to make sure they turned in homework, and to encourage students to utilize supporting outside resources such as the tutors. While some of the South and North High students performed satisfactorily on tests suggesting that they had mastered physics skills covered in class, a number of students at these schools relied on homework credit and good lab scores to pass the course.

Facilitator backgrounds also contributed to facilitator roles. Since the Central facilitator had a science degree, she could usually provide immediate answers to any content-related questions students might have. The other two facilitators might be able to answer some physics questions based on things they had learned in previous years, but their more frequent information/feedback role was to direct and encourage students to use other resources to find answers. Some of the South and North High students indicated that they called the tutors and found them helpful, but many were

reluctant to call or found it difficult to communicate with the tutors. And, since a student's ability to clarify and resolve conceptual or procedural questions ultimately affects student learning, the Central High students' physics performance was influenced to some degree by their facilitator's ability to answer their (infrequent) questions. Of course, Central High students also turned to each other for help. At South and North High Schools, the students had frequent questions; and whether their facilitators could answer the questions, or direct them to an alternative information source (and get the students to use the resource), also affected student learning. Unfortunately, the South and North High School students rarely took advantage of these resources.

Implications for Theory and Practice

This study supports the position of theorists such as Shale (1990) and Garrison (1989) who contend that distance education, while morphologically different, does not constitute a distinct educational process. The same factors that affect student learning in a traditional classroom also affect student learning in a high school distance education class; that is, learner skills, knowledge, beliefs, attitudes, and course/lesson design.

The study also suggests that responsibility for the quality and outcome of high school distance education courses is shared among all components of the distance education system; the course provider, the high school utilizing the program, and the local facilitators and students who are participating in the course. Specifically, the course provider, instructor, and designers, are responsible for providing effective, efficient instruction in the form of courses that maximize student achievement. This includes designing, developing and providing instruction, materials and activities, that, when utilized as prescribed, result in student mastery of clearly defined objectives. This also includes clear specification of desired student outcomes, required student entry skills (perhaps a specific pre-requisite skills test rather than designation of required pre-requisite courses), instructional materials and activities, a prescribed plan for course implementation, and other student support as required.

The responsibilities of the local school include assuring students possess the pre-requisite entry skills and supporting utilization of the course as designed by the course provider. This includes fully implementing the complete range of instructional activities in the sequence designed by the course provider. Or, if the school can not implement the course exactly as designed, it must assure that other components in the system can compensate for the instructional elements that were not implemented as designed. Specific school responsibilities include registering (and prescreening) students, establishing school calendars, bell schedules, and selecting and establishing facilitator availability. These are all factors which contribute, directly or indirectly, to facilitator and student roles and performance. Since two of the schools participating in this study deviated to some degree from the course provider's implementation recommendations (i.e., student pre-requisites, off-air activity block scheduling, and facilitator availability), this may provide evidence that one of the challenges high school distance education course providers will face is getting schools to utilize courses as designed. This is similar to the problems instructional designers have traditionally faced in getting schools to use courseware as designed (Burkman, 1987).

Finally, the study suggests that in addition to course design and school factors, facilitator roles and performance requirements will be defined by the needs of the students themselves. Students who are high on the motivation and willingness continuum but low on the ability continuum may require facilitator support in the form of instructional assistance (if the facilitator has subject area expertise) or encouragement and assistance in using telephone tutor or other external support (if the facilitator does not have content area expertise); whereas students who are high on ability but low on motivation and willingness will require facilitator support to help them stay on task and participate in class activities (Hersey, Blanchard, & Johnson, 1996).

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Planning Strategically for Technology Integration

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The role of technology in education has changed over the last five years. Technology is now being recognized as an educational tool. It is being used as a means to an end not as an end in itself. Research consistently shows that technology per se does not make school reform happen (Means, 1993). Many educators are now actively using technology along with effective teaching strategies to integrate technology into their curriculum. These changes or restructuring allow educators to significantly improve the teaching and learning which occurs in their classroom.

Appropriate strategies are the keys to realizing the maximum benefits of various technologies. However, effective strategies need not be utilized only for improved teaching. Effective strategies can and should be used for a variety of other purposes in the planning, implementation and evaluation of technology use in classrooms, schools and school districts. The planning process is where it all begins. Planning allows potentially beneficial strategies to be realized when they are incorporated into a framework that reflects a direction, proper support, and is accepted by the stakeholders. In addition, classroom plans, school plans and district plans must be integrative and mutually supportive.

Effective Plans

Planning, if conducted effectively, can enable a teacher, a school, or a school district to realize beneficial teaching and learning outcomes. Unfortunately, many teachers, schools, and districts are being forced to produce long-range technology plans that don't really reflect their needs, infrastructure capabilities and effective strategies for implementation. These long-range technology plans often are requested by administrative bureaucracies for the purpose of accountability, justifying the use of resources, and funding which often are initiated as a result of public demand. Many of the plans that have been developed are merely end products. They should really be developed and utilized as a tool, a means to an end. Too often these plans are evaluated out of context and they receive great recognition and awards in schools, school districts and nationally in technology periodicals. Recognition and awards should be given if there are significant improvements in teaching and/or learning. In particular, when technology is involved, we really want to see if technology is contributing to the improved teaching and learning outcomes. If not, other tools and strategies need to be utilized.

Plans - Components, Steps, Approaches

These recognized technology plans often include very important components that are needed to help insure that most needs and conditions are being addressed. Important components often include:

- Formulating a planning team
- Collecting and analyzing data
- Formulating the vision, goals, and objectives
- Exploring available technology
- Determining training and staffing needs
- Determining a budget and funding sources
- Developing an action plan
- Implementing the plan
- Evaluation

However, many of these technology plans are designed and developed with components or steps that are missing or approaches that are not appropriate. Hence, they may not be valid, accurate, and effective for the particular school and community where they are to be implemented. When the design and development is inappropriate, there is a high probability that many of the stakeholders, especially school and district administrators, are not going to buy-in and support it philosophically and financially. This greatly reduces the effectiveness of the technology plan. The Cradler (1992) study concurs that effects were greater when the development and implementation of a school plan were actively supported by the district.

Although some technology plans lack components or steps, clearly the most critical problem is their approach. Planners and developers often do not realize that the process of planning is just as important and often more important then the plan itself. In addition, the difference between long-range planning and strategic planning is enormous. Long-range technology planning is often required by schools and school districts around the country. Long-range planning is more traditional and product-oriented while strategic planing is mission-oriented, process-oriented, dynamic and change-oriented. Table 1 further lists some of the characteristics of these two types of planning.

Table 1.
Factors differentiation strategic planning from traditional long-range planning.

Traditional long-range planning	Strategic Planning
1. Emphasizes stability	1. Dynamic and change oriented
2. Tradition-oriented	2. Mission-oriented
3. Concrete and objective data emphasized	3. Subjective and intuitive data emphasized
4. Blueprint for the future, of future decisions	4. Vision of the future, to guide decision-making today
5. Deductive and analytical	5. Inductive and integrative
6. Product oriented	6. Process oriented
7. Reactive	7. Proactive
8. Internal focus	8. External focus
9. Relies on the tried and tested	9. Emphasizes innovation and creativity
10. Lock step process	10. Continuous and on-going process
11. The most persuasive persons set the direction	11. Consensus-oriented in determining direction
12. Facts and the quantitative are emphasized	12. Opinions and the qualitative are emphasized
13. Efficiency orientation	13. Effectiveness orientation
14. Planning office carries out	14. Institution wide development

Note: Excerpted from Lenning (1982). Figure from Meredith, cope and Lenning (1988)

Strategic Planning- Benefits and Key Elements

Strategic planning is what we should encourage in classrooms, schools and school districts. Bryson (1995) lists many of the benefits of strategic planning:

- Promotion of strategic thought and action
- Improved decision making
- Enhanced organizational responsiveness and improved performance-flows form the first two.
- Can directly benefit the organization's people

One key element in strategic planning involves the vision. Strategic planning involves designing and developing a direction, a vision of "what should be" or "what could be" (Herman, 1992). Without a clear vision, other planning efforts cannot occur effectively. Representative participation of stakeholders is critical in providing input and feedback in strategic planning. Stakeholders need to be involved in the process of inquiry, discussion, and decision making by consensus (Burkhart and Reuss, 1993). Stakeholders also need to be involved from the beginning, otherwise, if the organization cannot demonstrate its effectiveness against the stakeholders criteria, then regardless of any inherent worth of the organization, stakeholders are likely to withdraw their support (Bryson, 1988). A third key element involves research and assessment (scanning) to provide important information for decision-making. This information will allow planners and developers to identify and understand our external and internal environments. Often we know much about our internal environment but not much about our external environment. Bryson (1988) identified a number of key factors necessary when thinking about the scanning process, including:

- Selecting issues and trend "categories." He suggests political, economic, social, and technological;
- Identifying appropriate "scanning" sources (professional journals, key informants, newsletter, etc.);
- Understanding the cycles that issues in the external environment take: (i.e., How often does this issue come around?; How long does it usually stay within the "window of interest" by policymakers? Can your organization react rapidly to take advantage of the next "window"?);
- Asking effective questions to ensure effective external scanning; (i.e., Is this a new issue or trend: Were you surprised where it came from (source)? Does it fly in the face of the current "conventional wisdom"? Can you determine if there are patterns/trends?).

Lastly, another key element for strategic planning involves continuous improvement. The process can only be effective and efficient if it remains dynamic and involves strategies that encourage and support change.

All of the above elements are especially important when developing technology plans. These elements play a critical role in confronting issues and trends that constantly change and therefore warrant significant input form stakeholders to develop strategies that can be implemented by educators to provide students with the most effective methods and tools for learning.

Strategic Planning- Important Steps

A few of the major characteristics or key elements of strategic planning have been presented. It is also important to present some of the important steps that should be used to bring about the needed changes. The literature reflects several models for incorporating these steps. The following list is an attempt to combine the steps from models proposed by Handy (1992) and Bryson and Roering (1987) and Bryson and Alston (1996) and Burkhart and Reuss (1993):

- Initiate and agree on a strategic planning process
- Identify current resources
- Identify current mandates
- Identify stakeholders and their expectations
- Develop and/or refine mission and values
- Assess (scan) the internal environment- strengths and weaknesses
- Assess (scan) the external environment- opportunities and threats
- Identify and frame strategic issues

- Formulate strategies to manage the issues
- Develop an action plan
- Review, revise, and adopt the action plan with timelines
- Develop an effective implementation process including the evaluation (formative and summative) of programs, projects, and services.
- Continuous scanning and reassessment of issues, strategies, and changes needing to be implemented.

Space does not allow me to discuss these in detail. For further reading, I have referenced the appropriate authors.

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PRINCIPAL LEADERSHIP FOR SUCCESSFUL SCHOOL TECHNOLOGY IMPLEMENTATION

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There is no shortage in the current education literature about the need to reform our public schools (Sarason, 1997; Goodlad, 1997). Educators are being told they are not keeping up with the real world. Business leaders are complaining that schools are not producing enough qualified workers (Matthews, 1997; Wadsworth, 1997). Educators often are told that the schools of the twenty-first century must be organized differently from the schools of the twentieth century to meet the needs of an increasingly diverse society. Many educators recognize the need for a change and there is a strong call for reform (Glickman, 1998; Goodlad, 1997; Schlechty, 1997; Sarason, 1997; Hirsh, 1996; Sergiovanni, 1996; Barth, 1990).

Researchers (Fullan, 1996; Goodlad, 1997; Sergiovanni, 1996) have begun to question whether we are meeting the varied educational needs of all students. Also being questioned is the structure of schools and whether these structures are appropriate for educational institutions. Each has suggested that there are major changes that need to occur in schools if we are to meet the needs of students now and in the future. Fullan (1996) suggests that rather than think in terms of reforming schools, we need to think in terms of reculturing schools. He suggests that the values, beliefs, and norms of schools need to be examined to determine whether the existing culture of the school is preparing students for participation in a complex society that requires strong problem-solving abilities. To reform our present system, principals must change from their present role of manager to instructional leader. The key role principals play in schools is well documented and acknowledged (Buckner, 1997).

As, Szabo & Schwarz (1997) point out, instructional technology has great but unrealized potential for reforming educational systems. Proponents of educational technology advocate using technology to fundamentally restructure education: the business of how teachers teach and how students learn (Ellis & Fouts, 1994; Wirth, A.G., 1992). Past explorations of why the potential is unrealized have focused upon attempts to get people to change and the complexities of instructional use of computers. An important person in making change happen is the school principal.

Instructional Leadership and Technology

A survey of the literature in education points to the critical role of the principal as instructional leader in the school (LaRocque & Oberg, 1991; Henri & Hay, 1995). Pellicer, Anderson, Keefe, and McCleary (1990) state that "...instructional leadership is likely the most important function in a school for creating a productive and satisfying environment" (p. 41). Daresh (1997) makes the observation that because of the emphasis on instructional leadership, preservice programs have focused on learning experiences that help future school administrators "...oversee the teaching-learning activities in their schools as the primary area of attention and responsibility" (p. 5).

Lou Gerstner, (1994) CEO of IBM, claims that nothing matters more to America's schools than finding competent principals to lead them. Although the role of the school principal is frequently cited as the key element in school reform, it is not the solitary role of times past. It is a role that demands skills in enhanced team building, shared decision making, and increased technological competency.

Researchers at the Stanford Research Institute and Educational Development Corporation find that technology can be a powerful tool for supporting educational reform (1992). As many states and communities across the country are learning, transforming industrial age schools into information age schools is easier said than done (Dyrli & Kinnamon, 1994). The key to ensuring the success of technology in schools is the way in which technology is integrated into the school's curriculum. As Kinnaman (1994) observes, successfully integrating technology into education requires basic changes to our current model of schooling; anything less sells short both the value of today's technology and the future of education. School principals must understand the importance of technology for improving school management as well as its implications for improved instruction.

Technology with the right software equipment and instructional design can enhance the students' active

participation in his/her learning and encourage problem solving skills by involving them in realistic assignments. This transformation from industrial age schools into information age schools won't happen without active leadership by the school principal. If schools are to take full advantage of the educational opportunities available through media centers, principals must be knowledgeable concerning their vast potential. One of these potentials was addressed in the Lance study (1993) which revealed that quality school media centers significantly impact students' test scores.

Inhibitors to Technology Implementation

First, there are teachers and administrators who believe the lack of available money for technology is a problem when trying to integrate technology into the curriculum. Research shows that the amount of money available to a school district is not related to the innovative uses of computers. Exemplary teachers work in a representative range of communities and schools. However, they tend to be found in settings where school and district resources have been used to create supportive conditions (Becker, 1994).

Second, principals need to plan professional development programs for teachers. Professional development is essential for technology implementation in the schools (Solomon, 1995). Plans for professional development need to be cost effective and as non- disruptive as possible (Dwyer, 1995).

There is no scarcity of literature when it comes to professional development or topics related to professional development (Parker, 1994). There is a need whenever change or introduction of something new or unknown to a group of employees to have some training or professional development. For school administrators professional development is one of their major responsibilities. Research shows that a factor in creating trust between teachers and their principals involves principals being involved in teachers' professional development (MacNeil & Blake, 1998). Research also shows that teachers' job satisfaction is related to how principals' instructional management focuses on teachers' professional development (MacNeil, 1992).

Principals need to solve the dilemma of how to provide appropriate technology training for all the faculty. Dyrli (1996) recommends a number of key elements for a successful staff development, including: offering a variety of options, emphasizing skill development, providing hands-on experiences, tailoring programs to local realities, using genuine teaching examples, and providing supporting materials. Principals need to be aware that if the teachers are not the focus of the technology training, then technology will fail (Guhlin, 1996). Teachers have to feel involved in the process of integrating technology into the curriculum. This involvement will ensure that the teachers take personal ownership for this responsibility. Once personal ownership has been established, it is easier for the teachers to work toward goals, because they now have more purpose and meaning. The main thing to remember is whatever training the teachers have, it is crucial that it applies to them as professionals as well as individuals.

Third, principals must be prepared to deal with teacher resistance to technology being integrated into the curriculum. Many teachers perceive technology as another burden of responsibility added to the already overwhelming load of a teacher (Hartzell, 1996). Another area of resistance happens "...because teachers believe that interpersonal relations are essential in student learning, the use of technologies that either displace, interrupt or minimize that relationship between the teacher and the child is viewed in a negative light" (Cuban, 1986, p. 61). Principals have to be prepared to provide extensive teacher training in the integration of technology into the curriculum (Weiss, 1994). Principals need to create an environment conducive to maximizing technology integration into the curriculum. A faculty that becomes comfortable with the ideas of technology will more easily integrate it into the curriculum.

Methodology

A survey technique was used to gather data. Specific items were developed for the categories of implementing technology into the classroom and the principal's perception of what are the inhibitors to integrating technology in the schools' curriculum. All 112 school administrators, both principals and assistant principals in a school district in southeast Texas were given the survey. 64 or 57.14% of the surveys were returned. Specifically they were asked: How important is technology in your school? How important is staff development for your teachers to learn technology as a curriculum tool? Estimate the percentage of staff development time this year your teachers will use to train on any type of technology? And, what is/are the major inhibitor/s to integrating technology in the classroom? The data were treated by using SPSS to determine frequencies and descriptive statistics to analysis the responses to the questions: How important is technology in your school? How important is staff development for your teachers to learn technology as a curriculum tool?

Respondents were also given the opportunity to add open-ended responses to the following questions: What is/are the major inhibitor/s to integrating technology in the classroom? Estimate the percent of staff development time this year your teachers will use to train on any type of technology. A frequency table was used to show the results of their answers as well a histogram to show the responses for the amount of time designated for professional development. A pie chart is used to show the responses to the inhibitors to integrating technology in the classroom curriculum.

Findings

In answering the first question, "How important is technology in your school?" the principals reported

technology to be very important (See Table 1 and Figure 1). 67.2% of the respondents answered that technology is very important and 90.6% rated it a 4 or 5 in importance.

Table 1
Importance of technology: 5 represents most important 1 represents not important

Value Label	Value Frequency	Percent	Valid Percent	Cum Percent
2	1	1.6	1.6	1.6
3	5	7.8	7.8	9.4
4	15	23.4	23.4	32.8
5	43	67.2	67.2	100.0
Total	64	100.0	100.0	

Valid cases - 64, Missing cases - 0

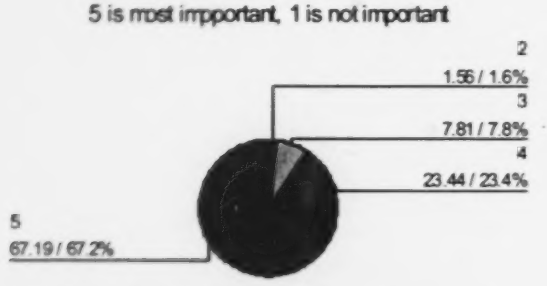

Figure 1. Ratings for the importance of technology
5 = most important, 1 = not important

Principals rated the importance of the teachers learning technology as a curriculum tool also very high. (See Table 2 and Figure 2). 60.9% of the respondents answered that staff development to learn technology as a curriculum tool is very important and 89.0% rated it a 4 or 5 in importance.

Table 2.
Importance for your teachers to learn technology as a curriculum tool

ValueValue Label	Percent Frequency	Valid	Cum Percent	Percent
2	1	1.6	1.6	1.6
3	6	9.4	9.4	10.9
4	18	28.1	28.1	39.1
5	39	60.9	60.9	100.0
Total	64	100.0	100.0	

Valid cases - 64, Missing cases - 0

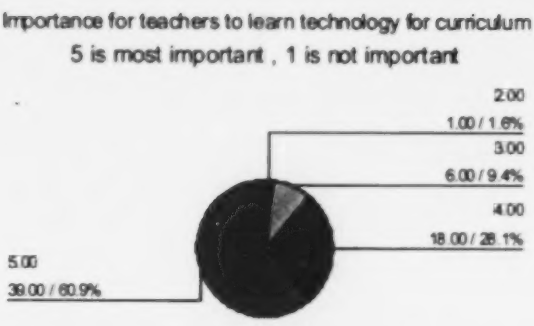

Figure 2. Importance for teachers to learn technology for curriculum
5 = most important, 1 = not important

In answer to the question, "Estimate the percentage of staff development time this year your teachers will use to train on any type of technology" the principals' response was inconsistent with the amount of importance they attached to technology and its implementation as a curriculum tool (See Table 3 and Figure 3). 85.2% of the respondants indicated that 25% or less of the total annual staff development time would be allocated for training to use technology in the curriculum. The histogram visually demonstrates the amount of staff development time principals estimated.

Table 3.
Estimated percentage of time for staff development using technology.

Value Label	Value Frequency	Percent	Valid Percent	Cum Percent
00	3	4.7	4.9	4.9
1	1	1.6	1.6	6.6
5	3	4.7	4.9	11.5
10	16	25	26.2	37.7
12	1	1.6	1.6	39.3
15	3	4.7	4.9	44.3
20	11	17.2	18	62.3
25	14	21.9	23	85.2
30	4	6.3	6.6	91.8
35	1	1.6	1.6	93.4
40	1	1.6	1.6	95.1
50	2	3.1	3.3	98.4
100	1	1.5	1.6	100

Valid cases 61 Missing cases 3

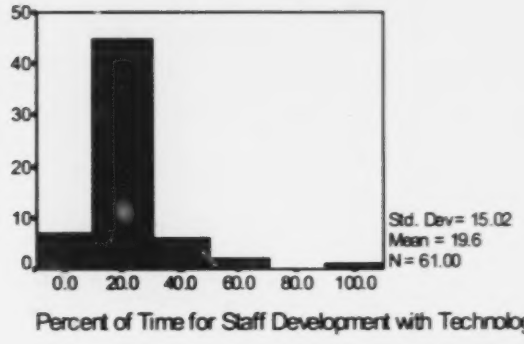

Figure 3. Histogram showing estimated time for annual staff development with technology.

Conclusion

Principals and assistant principals in the southeast school district in the state of Texas answered that technology is very important in their schools and that it is significantly important for teachers to learn technology as a curriculum tool. This study also shows that the main inhibitors to implementing technology in the classroom are: 1) lack of financial resources for hardware, software, and infrastructure, and 2) lack of time for professional development and planning. Teacher resistance was not shown to be a high inhibitor perhaps because technology is become more common to the classroom.

Principals and other school leaders must accept the challenge to create supportive conditions which would foster innovative uses of computers. There needs to be closer alignment between the amount of time for professional development with technology and its degree of perceived importance. As one prepares the faculty in the professional development plan for integrating technology into the curriculum, higher level support must be given so that school faculty have access to computers during instruction time and planning time.

Recommendations

Technology is the means to increasing learning efficiency. Technology can be used to better display information, increase access to information, improve information sharing, and organize better class presentations. Technology is not a panacea for educational problems, but by combining technology with applicable learning models, the overall quality of education is enhanced. Students raised in an age of technology demand student-centered and led learning. Educators must discover and develop how to implement new technologies into the learning environments and focus efforts on facilitating learning (Adams & Jansen, 1997).

At each level, the funding, training, and leadership issues must be addressed simultaneously if technology in the curriculum is to grow and have an impact on the reform of public education. Principals must use their existing resources wisely and creatively. They must think "outside the box,"; they must think in a fluid environment.

Additionally, state legislatures, corporate businesses, the federal government, and, local school boards must continue to look critically at their priorities. Elected officials must continue (or begin) efforts to "re-tool" education for the next century. Principals and teachers are, for the most part, ready. They must have the resources to proceed.

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FACILITATING INTERPERSONAL COMMUNICATION WITH TECHNOLOGY IN PRINCIPAL PREPARATION PROGRAMS

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Technology is often cited as a cause for a more impersonal world. Technology has created speed and efficiency at the cost of personal encounters, long gone are conversations with real live phone operators. We have been inundated with recorded messages that tell you to press a number if you want a place, person, venue or menu. We no longer know the person who delivers the mail or the paper. Our world some would say is increasingly becoming more impersonal as we become more technologically advanced.

The evidence of the need for and the importance of human contact and interaction has never been more important (Adler, Rosenfield, Towne & Proctor II, 1998). Technology has freed our time and made it possible to have better communications than ever before, yet the complaints about the use of technology causing isolation continues to be pervasive in our culture. This paper illustrates and explains the procedures, benefits, and precautions of using technology to personalize the learning experience. Specifically, conferencing technology was used to communicate with the authors of a text book, The Handbook for Teacher Leaders, used in the principal preparation program.

The problem as discussed in the literature

The literature shows that our schools and universities are often being blamed for becoming more detached and less personal in their operations. Much of the literature commenting on the use of technology in education has ominous tones of "use it or lose it". Sudzina (1993) states that teachers' traditional beliefs may inhibit them from taking instructional risks and implementing technological innovations. Burke (1994) claims that higher education is trapped in a time warp and that new information technologies present a critical challenge which cannot be ignored if higher education is to succeed or even survive. He suggests that to succeed, faculty must overcome their own fears and resistance to technology and alter the way they teach and, therefore the way students learn. Technology can help higher education link access and excellence by tailoring learning to the diverse student needs and styles, while also allowing colleges to respond to critics by containing costs and improving quality. Twigg (1994) points out that these new delivery systems for teaching, together with our increased knowledge about how people learn are driving changes in attendance patterns and institutional structures in higher education.

Bagley and Hunter (1992) suggest that changes in teaching will come about because of the synergistic interrelationships among the changes in our views of learning/teaching, the integration of technology, and the restructuring in our educational systems. Jensen (1993) proposes that the emergence of hypermedia is bringing new and different possibilities for college teaching than did previous technology. He predicts that materials available to students, styles of teaching and learning, and the role of the instructor will change dramatically. Multimedia instruction, a computer-based system incorporating video, audio, and digital storage media, provides educators with the tools to bring learning alive. Multimedia may become the most common form of instructional technology with planning, adequate funding, and faculty development.

Thomas (1994) comments on the second revolution that is moving the use of computers into the area of instruction rather than administration. As the world moves into an electronic-driven postindustrial revolution, new realities call for change in the education system. The impact of technological changes will be reflected in more "expert" teaching via use of computers and videotapes, and replacement of the conventional paper, pencil, and book by computers. MacKnight (1995) predicts that colleges and universities will have to support advancing information technology including developing "supertech" classrooms. Whereas the mission of universities in the past was to accumulate, refine, and pass on knowledge, their new task is to educate and train people to manage and gain access to the universal data base of knowledge.

These predictions and trends can often cloud and even remove from the agenda the critical human component in the process of learning. Historically there were predications that

new technologies of radio and later television would replace the need for teachers and professors in the classrooms when in fact the opposite is true. The role of technology has almost always made promises for revolution and cost reductions. The teaching profession has always had an inordinate requirement for human resources compared to other organizations. This requirement of human resource quickly becomes the target for reduction in an attempt to become more efficient and effective. Technology often promises effective and efficient results; therefore, it can logically be proposed that the use of technology will result in the need for fewer people and reduced costs based on a more effective and efficient use of resources. McKeachie (1995) points out that during the 1950's television seemed to offer great promise for coping with the increased numbers of students as a result of the baby boom. Skinner (1954) advised that mankind was on the threshold of an exciting and revolutionary period and that education must accept the fact that "sweeping revision of educational practice is possible and inevitable" (p. 97).

Sudzina's (1993) study of the literature suggests, among other findings, that computers cannot replace good teaching; teachers are critically important in classroom computer use; computers can be an important component of an active learning environment; teaching is generally complicated through the use of technology in the classroom. People still need human contact. That is why solitary confinement is still the worst punishment that a prisoner can receive. We should have learned before the computer age the valued lessons from our colleagues before us that technology cannot substitute for teachers; learning still depends on student activity and thought. We should also have learned that technology when appropriately used can facilitate student learning. McKeachie (1990) who began his college teaching career in 1946 wisely observes the greater the advance the greater the complexity. " The circle separating what we know from the unknown becomes even larger" (p. 197).

Today a global shift in education is taking place, moving from a teaching focus to a learning focus. In the past decade, theories of the social construction of knowledge have resulted in the widespread use of collaborative learning techniques. Computer technology has been in the forefront of this movement,. This technology is most appropriate to complement face-to-face meeting with teachers.

Recent literature contributions about the technological revolution (Bruce & Shade, 1994) write about the potential of compressed video and presents teaching and learning strategies using this technology. One application of this technology was used on October 24, 1995, in the Instructional Leadership class at the University of Houston Clear Lake. Graduate students in the Leadership program were given the opportunity to speak with Leonard Pellicer and Lorin Anderson about their recent book, A Handbook for Teacher Leaders, which was used as a text and resource for this class. This highly readable book, with theory grounded in research, urging best practice was to be the topic of the conference. The purpose was to try and aid the students become more reflective about the content of the book. The premise was that having a visual and auditory communication experience, face to face, students would be able to more readily identify with the authors and be more motivated and thoughtful about the content of the book.

Design of the Cu see Me Conference

In order to use CUSM you must have a computer with a video digitizing card (e.g. any of the AV Macintoshes), a video camera, a microphone, and TCP/IP connectivity to the Internet. The software is free and is available over the Internet. While CUSM can work over a modem and phone line, the data transfer rate is so slow that the audio and video break up considerably and limit conversation. A better alternative is a direct connection to the Internet with a T1 line.

Any two CUSM users anywhere in the world can converse directly with each other simply by entering an IP address into the "Connect" dialog box of the program. If the person with the address you enter is running CUSM and is accepting messages, you will be linked to that person and can begin your interaction. However, if you desire to have a video-conference with more than two people, each person involved must enter in the IP address of a computer running some software known as a "reflector." This software is also available free of charge over the Internet, and it allows up to eight people to interact in real time. If more than eight people need to hold a conference, you must have a reflector site linked to another reflector site. Using this technique you can theoretically have an unlimited number of sites connected. However, as more sites are added the amount of audio and video data being transmitted will quickly overcome the ability of most networks to keep up and transmission quality breaks down rapidly.

Internet-based video conferencing software is rapidly being developed. Although the version of CUSM that was used for this conference was restricted to black and white video in a fairly small window, at a frame rate of about 15 frames per second, the market place at the time of the presentation of this paper has available a version that overcomes some of these limitations. Some other companies (including Apple computer) already sell competing software that allows color and improved frame rate, but in our opinion sacrifice interactivity and audio quality. The August 1996 magazine of Windows Sources has an advertisement for the Enhanced CU-SeeMe for under a hundred dollars running with a 28.8 modem "all in full color" (p. 150). At any rate, the telephone companies should be nervous, because Internet based videoconferencing is here, is improving rapidly and is free.

Results and student reaction

The conference was not without its problems. The students point out this out clearly in their comments; but the reaction of the students overall was favorable. Over all the comments suggest that the activity was worthwhile. The following examples of comments supports the usefulness of the activity: enlightening, grateful, quite unforgettable, I will refer to it many times in the future, a very worthwhile activity, it was a really innovative approach to meet people whose ideas have been laid out for the world to utilize, thanks for that opportunity; the process was an enriching one, I enjoyed the interview, I found it fascinating and invigorating, very exciting to experience first hand the technology that is emerging.

The comments show that the session made the authors' messages from the book more personal to the students. On several occasions in later class sessions, the discussion and the reflection of the students turned to the dialogue of the "Cu see Me" conference. The internalization and personalization of the discussion were evident in the students' comments. "It aided me in internalizing the philosophy, for the words became people."

Preparation of the students before the session should include instruction about the specificity of the questions particularly about their own situational problems and the search for the answers in this form. Students need to focus on the message of the authors. Questions could have been better planned and agreement if not consensus on the questions planned before hand. Some students still expect that the process will give them the right answers and have difficulty with the role of the reflective practitioner. Some of the students still expect that the process will provide right answers and that "if we just do these things" everything will be perfect. This notion gleaned from the comments became an opportunity to discuss and review the importance of developing as reflective practitioners.

The responses indicate that even when the students did not get the answer they wanted they still could feel that their objections were heard: "We could voice our thoughts, the discussion became important." It was also suggested that "It would have been especially helpful to have had several conferences throughout the semester as the book was in the process of being read, thus allowing for a more detailed and comprehensive questioning regarding the book's chapters." Although it was also suggested that the technology was really important for itself, one student made the observation that:

The format of this allowed me to look beyond the words in the book to the opinions behind them. This helped me to make more practical sense out of the book. The authors' attitudes led me to believe that the basic foundation of the book was the idea that teachers can solve the problems in schools if they only take the initiative to do so.

Many of the students were affected by the messages of the authors differently than were those who wanted specific answers from the session ". . .also showed the readers that the authors were trying to communicate ideas and concepts for teacher leaders, not necessarily specific situation solutions." Another student commented that ". . . although they did not have the perfect solution to every problem posed that, in effect, became the lesson: that there is no one answer for such a multi-faceted business and that lesson is the most important one for us to learn!"

The session had a motivational effect on the students as well as an informational purpose. A student stated that the session, ". . . sparked my interest in learning more about technology and how we can use it effectively in education." Another stated, "I think that this type of activity would be great in the classroom."

Even with some of the glitches and the newness of the technology the students moved very quickly to the purpose of the conference and the technology moved to the background to facilitate the experience. One student commented that, ". . . once I became accustomed to the format I had no trouble concentrating on what the authors had to say."

There are many benefits of this type of conference for the authors. The students as stated earlier made connections that were very important. Being able to put a face to a name made the authors message more important and real for the students. A sample of some of the comments were as follows: I was very impressed with Pellicer and Anderson for taking the time to answer our questions. Both men seemed to have a pragmatic approach, and were in touch with what was really going on in the schools. They both had such a great sense of humor and seemed like genuine people. Both authors fielded the question very well . They are truly concerned with making education better by improving teachers' abilities and influences Talking with Pellicer and Anderson was a treat. They appeared to be genuinely helpful. Being able to meet the authors Pellicer and Anderson via computer network was an experience I'll never forget. By meeting Leonard Pellicer and Lorin Anderson, I found them to be quite knowledgeable and practical, giving credibility to what is said in their book. Their personable and genuine natures made me feel as though I've known them for years.

Preparing for such a conference requires planning and coordination. You must coordinate the session to take place at a time that is convenient for the authors, the students in our case, the technicians, and the booking of the lab facilities. This all takes a great deal of time and coordination. Is it worth it? Yes. The student comments indicate how much they appreciate the effort. The overall result has had significant and lasting effects on both the learning of the students and their relationship with the course instructor.

The students appreciate the efforts that were made and were genuinely grateful for the experience.

Discussion and Conclusions

As can be readily seen from the students' comments, there were some technology problems. For example the slowness of the sound and video and the breaks that were experienced in the transmission. The comments also reflect that the students overall appreciated the experience. It also showed how the same conference affected the students differently. They grought to the conference their own attitudes, beliefs and values, and used their learning experiences to either validate, or modify their positions.

Overall the learning experience was valuable and had many positive results. The student interest and commitment to the content of the course increased. Also, students appreciated the efforts made on their behalf. The material of the book became more relevant as the students connected on a more personal level with the authors. There were longer lasting effects to the discussions as observed in later classes.

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School Administrators: Leaders in Technology?

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During the last five years, education in the State of Georgia received a boost through lottery funds, which were specifically designated for technology and multimedia in all schools. Each school received a satellite dish, computers for laboratories and classroom use, and various software programs. The extent to which this equipment is used, however, often depends on the support of the school administrators. Staff development programs offer assistance to teachers, but few are designed for the administrator. Support or lack of support from administrators regarding computer usage in schools is often a "hot or touchy" topic for teachers who desire more support or who would like the opportunity to explore more current uses of the internet. University courses in technology, at the graduate level, for educational administrators are just becoming part of graduate course requirements. Since many principals received their degrees and endorsements prior to new guidelines, a study of principals' use and knowledge of multimedia use will provide information for future course work.

Barriers and Common Use of Technology

School administrators, in many cases, excited or not over the hype of technology, have major hurdles to overcome: installation of equipment and curriculum planning. Technology and funding equity are concerns of the past decade (Arch, 1986; Moursand, 1986). Often the schools had to rewire electrical outlets, curriculum had to be rewritten to encourage the use of technology, and teachers needed training. Media specialists seemed to be the faculty members who have accepted and use technology. Most school administrators use the data collected and stored in technology programs for grading, demographics, budget management, and scheduling Picciano (1998), however, these programs are usually programs developed by and for the school district. Additionally, it is usually the support staff who maintains the programs asking only for the administrator's signature on the outbound copy. The head of any school is the administrator, but are they also the leaders in technology? In order to answer this question, we need to see where the schools are, the perceived attitudes and needs of the faculty, and whether or not administrators have received support through the literature.

What's in the Texts?

What are the trends of the future? We are concerned about competing in a global economy, and textbooks ask us to think about educational reform and how to prepare students for the next century. Yet most of the discussion involves questions such as: How will teachers react when the students appear to know and/or understand technology better than they do? How do we use the web? Should all students have computers at their desks? Other discussions center on curriculum implementation, instructional approaches and assessment of students' work (Knapp and Glenn, 1996). Books and articles such as those of Geisert, P.G., & Futrell, M.K. (1995), Becker (1994), Schlumpf (1991), and others discuss teacher empowerment, staff development techniques, and trends, but they do not address the school administrator's role. If media specialists, curriculum planners, classroom teachers, and students are all in the big picture, where is the school leader? The following questions guided this research. What part does the expertise of school administrators play in supporting technology? What is the extent of their personal use of technology? What is their vision of schools of the future?

Methodology

A survey questionnaire was developed and sent to seventy-three school administrators in eleven counties in northwest Georgia. Fifty-seven were returned on or before the due date given. The questions included a Likert scale addressing school administrator's perceptions of technology and their personal and school use of technology. An open-ended question asked them about their vision of schools in the future. The demographic data divided the administrators into two groups: principals and assistant principals. The respondents were also asked for the school level, years in this current position, and their gender. Data were tabulated and a content analysis was done with the open-ended questions.

Findings

Responses to the open-ended questions found that more men than women had home computers for their personal use. Women reported that the family had a personal computer, however, the children were the primary users. Women tend to use the home computers for email, or

ordering books. Men indicated that they spent more time on the computers at home, and that the web use was for sports, news, and maps.

School administrators, who used computers or other technology at home, were more inclined to also use computers at school. A few administrators stated that they often worked after school hours, or during brief periods when things seemed to be running smoothly. Women administrators did not report "playing" on computers at school, but more women than men, especially elementary school administrators, said they did much of the district reports themselves.

Most of respondents (89%) male and female, across all school levels were not sure what on-line learning was or if they would implement such a thing. The vision for schools of the future seemed to indicate that a majority of students would attend some or all of their lessons from home or a laboratory. The concern was for students of low socioeconomic areas. A number of administrators also felt that the technology for the future is just being developed. What is the impact for the future? Surprisingly, many stated that unless all areas in all the countries had equal use, there would not be a real impact that made a difference in students' abilities.

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A Planning Process for Creating Collaboration Among Deans

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Of those who should be on the information superhighway, faculty and students in colleges of education are among the most important. (Hill & Somers, 1996)

In the fall of 1995, the Northwest Educational Technology Consortium (NETC) was funded by the U.S. Department of Education, Office of Educational Research and Improvement. A small portion of the funds was allotted to support teacher preservice education. The northwest region currently has 54 four-year colleges or schools of education (COEs), both public and private: 5 in Alaska, 7 in Idaho, 7 in Montana, 15 in Oregon, 19 in Washington and 1 in Wyoming.

During the NETC Proposal planning stage, a set of outcomes was developed from the input of the three Northwest Deans of Education who were members of the NWREL Board, and from the lessons learned from innovative COEs as described in the Office of Technology Assessment (OTA) report Teaching and Technology: Making the Connections. The outcomes included the knowledge that NETC will be a politically neutral organization and able to facilitate approaches and organize regional meetings that would be more difficult for a single COE or state higher education organization to attempt. In order to meet the needs of COEs, NETC proposed the following outcomes:

- Reconceptualize the role of technology in preservice education.
- Form partnerships and encourage collaboration between interested stakeholders.
- Understand the impact of new technologies in preservice education.

The Strategy

In December 1995, NETC convened the three deans who had helped with the proposal and asked:

- How to best accomplish the three goals (listed above)
- How do we do this with limited funding?

Their unanimous response was, Let us (Deans) get together and talk! We seldom have the opportunity to get together and talk about a specific issue. We are either lectured to or the agendas are too broad, so we send a substitute. The issue of integrating technology into teacher preservice education is too important to ignore.

The three deans suggested for the first year of funding that NETC establish a planning council, hold a conference of deans (Deans Forum), contact state educational technology experts, and hold a regional conference of Deans, faculty and state educational technology experts.

Planning Council Established

In early spring, NETC established the planning council: Dean Allen Glenn, University of Washington, Dean Robert Everhart, Portland State University, Dean Dale Gentry, University of Idaho, Dean Dan King, University of Wyoming, and Dean Don Robson, University of Montana, Missoula.

Deans Forum I

The planning council Deans convened via conference calls and e-mail as to how to accomplish a meeting of deans. The planning council chose to have a Deans Forum focused on Integrating Technology into Teacher Preservice Education. The forum was hosted in April by Portland State University and the participants paid their own travel. Hotel, per diem, forum material costs, and all of the Planning Councils' expenses were covered by NETC. The forum was held as a post conference activity to the Northwest Council for Computer Education (NCCE) conference. NETC paid for the Deans' conference registration. The NCCE conference focus was on innovative use of educational technology in the K-12 classrooms. Attendance was encouraged to provide a link between K-12 and preservice teacher education.

The atmosphere and dress for the Deans Forum was casual, and substitutes were discouraged. The environment thus enabled Deans to speak freely among their peers about sensitive issues. The invitation letter asked the Deans to come prepared to discuss the issue of technology. In order to prepare them, a survey and papers written by Dr. Christopher Dede were sent.

The survey provided a snapshot of what was happening at each COE, how technology was used in the preservice teacher education program. The results were provided to the Deans prior to the forum and enabled the Deans to quickly connect with other Deans experiencing the same problems or issues. An added benefit of the results was that time was saved at the forum. The Deans did not have to give an in-depth oral report of the role of technology in their program.

The agenda covered a Friday dinner/social and an all day forum on Saturday. The evening dinner provided time for the Deans to meet. An overview of NWREL and NETC was presented. Dr. Chris Dede, a futurist in the field of Educational Technology was the Saturday morning keynote speaker. Chris Dede is a Full Professor at George Mason University in Fairfax, Virginia, where he has a joint appointment in the Schools of Information Technology & Engineering and of Education. He currently is working with the U.S. Advisory Council on the National Information Infrastructure helping them think about their education recommendations. During the afternoon, representatives from the Intel Foundation, the Murdock Charitable Trust and the Meyer Memorial Trust spoke and interacted with the deans. These specific foundations were invited based on their funding higher education in the Northwest. Time was allotted for small discussion groups with the foundation representatives after the keynote.

The two NETC representatives managed the meeting, yet it was the Planning Council's responsibility to facilitate the discussions. Each of the Planning Council Members had a visible and audible role in the forum.

There was a total of 28 attendees: 15 deans of Colleges of Education, 5 university representatives, 2 Washington State Department of Education representatives, 3 Foundation representatives, 2 NETC representatives and 1 Keynote speaker. All six states in the region were represented (Alaska, Idaho, Montana, Oregon, Washington and Wyoming).

The major outcomes of the meeting included excitement to continue the discussion, initiate a listserv, and have a second forum in the immediate future.

Deans Forum Listserv

From the request of the first deans forum, a private listserv was established for the deans in May. It has since served as an important link for communication. Of the 54 deans, only three do not have Internet connectivity. For these special cases, fax and phone are used.

Only topics concerning integrating technology into teacher preservice education are posted. The Listserv is housed and moderated at NWREL.

Planning Council Advises

The evaluation of Deans Forum I was sent to the Planning Council. They agreed that the next step was to have a second Deans Forum that was more focused on one or two issues. With the enthusiasm high, it was suggested to have the forum prior to the fall semester.

Dean Carol Merz of the University of Puget Sound was added to the planning council to represent small, private colleges.

Deans Forum II

The second forum was held at the Puget Sound Education Service District in Burien, Washington, August 1996. Again, participants paid their travel. NETC covered hotel, per diem, forum materials, and all of the Planning Council's expenses.

Dr. Linda Roberts, director of the Office of Educational Technology, U.S. Department of Education, was the keynote speaker (Appendix E). The forum was identical in atmosphere to the first, providing time for discussion and comments. The second forum had a double focus of assessment and technology planning. Much of the discussion revolved around policy and call for action. (Agenda - Appendix D)

In order to prepare the Deans for the forum, a copy of Linda Robert's proposed keynote address was posted on the listserv prior to the forum. Dialogue was initiated and moderated among the Deans by the Planning Council.

Thirty-four people attended: 25 deans of colleges of education, 2 university representatives, 3 Washington State Department of Education representatives, 3 Northwest Regional Educational Laboratory/Northwest Educational Technology Consortium representatives and Linda Roberts. Five of the six states in the region were represented, Alaska, Idaho, Montana, Oregon, and Washington. Wyoming only has one college of education and the dean was not able to attend due to a previous commitment.

Two of the NETC representatives managed the meeting, yet it was the Planning Council's responsibility to facilitate the discussions. Each of the Planning Council Members had a visible and audible role in the forum by planning and conducting the seminars. They introduced the keynote speaker, guests and other planning council members. They took responsibility for the meeting room arrangements, acknowledged those involved, and were the center points for discussions and questions. This decision may have helped build a more collegial environment and ensure participation by deans.

The major outcomes of the meeting included the desire to collaborate across university and state lines along many veins of interest, initiate research in the area of technology and teacher education, continue the survey of schools of education, and actively seek outside funding.

Future Activities

The second deans forum set the stage for research. It was agreed that action was needed. With the council's advice and the deans input via the listserv, we plan to submit varying proposals to funding agencies for research

and professional development activities for teacher education faculty. In the farther future, the deans would like a large conference for faculty concerning integrating technology into their instruction. As NETC and the deans plan, the following issues are key:

- What next concrete activity can we design to sustain interest?
- How best to insure that it is specific enough to lead to something real but at the same time broad enough to engage a diversity of institutions in the effort.
- Where do we continue to get the leverage dollars to keep the group going?
- Who might be the next set of folks we to talk with (K-12, community colleges, and /or private businesses)?

Some specific research projects have been suggested and are to be acted upon in the future:

1. Identifying teams of 'faculty experts', faculty who are successfully integrating technology into the preservice curriculum. The teams would travel to other colleges and schools of education to deliver workshops or help develop technology plans.
2. Increase the amount of collaboration between higher education and K-12 on the issue of technology.
3. Examine the preservice teacher education curriculum. Through this evaluation, determines ways to better use the faculty and students' time to meet the needs of the 21st century classroom.
4. Finalize survey results in an executive summary format to disseminate.
5. Construct a webpage for COEs.

Conclusion

During the first year of operation, 93 percent of the Northwest Deans of Education have been actively involved with the project via the listserv, the survey, and/or participation in the forums. A high level of trust has been achieved through these activities. We are in the process of collaboratively writing proposals to outside funding agencies.

Lessons learned revolve around leadership, environment/atmosphere created for the forums, logistics of the forums, importance of keynote speakers, and open communication.

Leadership was provided by the Planning Council. Not only did the Planning Council Deans represent their school in discussions, but also the entire region's schools and colleges of education, both public and private. Their concern was how to work together and how to get 100 percent participation. Each of the Planning Council members is seen as a leader at their university and in their state. Turf battles were put aside. The Northwest Deans felt at ease to contact the council members and voice concerns, questions, and comments. The Council in turn felt at ease in contacting NETC and focusing the forums on immediate and future concerns of the Colleges of Education. NETC, in turn, does not hesitate to ask the Council for advice and assistance.

The environment/atmosphere set the tone for the forum. It was relaxed, plenty of non-elaborate food was provided, and it was hosted by an institution. Having the meetings at local education facilities allowed the deans to see what was happening on another campus. It was also a way to save funds for other activities. The sites were chosen based on close proximity to airports and in different states.

Logistics of the forum were handled by NETC (all arrangements for hotels and meals). The Deans provided their own transportation to and from the forum. All activities and materials were coordinated through NETC. This simplified and centralized the paperwork. The agenda was organized by the Planning Council and each of the discussion groups was facilitated by a council member.

The keynote speakers were extremely important to the success of the forums. Chris Dede was seen as a 'framer'. He put educational technology into focus and stretched it into the future. Linda Roberts brought a more down-to-earth approach of what was happening at the federal level and what the deans could and should do. Both speakers stayed for the entire forum and participated in the small group discussions. At the end of the day, they added their comments and helped synthesize the day's activities. Having the foundation representatives at the first forum was a major draw for many of the deans. It was presented to both deans and foundation representatives that this was a time for discussion, not a time to badger for money.

Overall, one of the major points of this project has been the limited amount of funding. The deans believe that this is an important issue and needs their attention and support. They have proved the importance of these forums by funding their travel to the forums, communicating through the listserv and assisting with proposal writing. The communication has been a major key to the success. Each of the planning council members is a respected dean in the region. They are easy to approach and are helpful in finding ways to make the forum work. NETC has a toll-free number and Internet accessibility. Even with tight funding, communication is readily accessible.

In summary, the key points for success for those who want to have form a cohesive and collaborative group of deans include:

- Select a topic that deans find worth their time
- Make sure that deans play an active role in deciding and conducting the events
- Utilize technology as much as possible to facilitate communication and to help in pre-conference knowledge building
- Identify key speakers, have them address specific topics; remain for the day to insure interaction between them and participants

- Create a series of "do-able" projects that will result in visible products in order to sustain deans interests and participation
- Keep meetings informal with ample time for discussion of key issues

For further information, check out our web site: http://bsuweb.bemidju.msus.edu/~govdocs/e-docs/ota/teacher_tech/toc.html.

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Leadership for a Technology-Rich Educational Environment

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Recent political and media campaigns have suggested that the number of computers in the school building is a measure of the value of that school. School districts and other educational institutions have responded to this public pressure by purchasing computers, installing networks, developing computer curricula, and providing teacher workshops. In spite of these efforts, schools and institutions are essentially unprepared to integrate computer technology into their everyday teaching and instructional responsibilities.

A great deal of discussion is directed at the issues related to preparing teachers to utilize new technologies, but what is abundantly clear is that the people who are expected to provide leadership and participate in key decision making processes regarding technology integration are being left out. Increasingly, educational leaders are expected to provide direction and support in a technology-rich environment without the benefit of understanding the technology and human elements that are necessary to make that technology an effective instructional tool.

Efforts to develop technology-rich educational environments have shown that there are key elements that are critical to the successful integration of computers into the everyday efforts of the people working in those environments. This paper explores the attitudes, skills, and knowledge that will enable individuals in educational leadership positions to function effectively and to provide support to create and maintain technology-rich educational environments. Our discussion is guided by five elements; vision, access, time, support, and assessment; the understanding of which we believe are essential to the meaningful integration of technology into the teaching and learning environment.

Developing A Vision

There are vague notions that using computers in schools is good. These notions are usually based on simplistic ideas that the use of computers will better prepare the student for the workforce and that there are efficiencies to be gained by their use. The truth about the use of computers is a much more complex reality that must be understood before computers and their related technologies can truly support a learning environment. A vision of the role of technology in learning must be developed that can give direction to decisions about the purchase, deployment, support, and use of the technology.

Currently, many educators believe technology and telecommunications are essential tools for supporting a transformed teaching and learning environment. The problem, however, is a lack of understanding about how technology and telecommunications are to be integrated into the educational environment. An important consideration is the role of the administrator in this transformation. The development of a vision to guide the integration of technology into the teaching and learning environment usually begins at the school level with the principal.

Writing on effective schools suggests that the principal can have a major impact on efforts to improve the organization and delivery of services to students (Bossert, Dwyer, Lee, & Rowan, 1982). McCall (1986) added that what is needed in times of reform is principals who understand the problems and critical issues of our education system. In 1994 The Education Commission of the States defined thoroughly restructured schools. Such schools have set high, world-class standards and ensured that those expectations are incorporated into the classroom culture by altering curricula and instituting teaching methods that accommodate the needs of all students. They also change management and administrative policies so they reward teacher initiative and innovation.

There are several modes for effecting change in schools (Sashkin, 1988). In order to successfully foster change in an increasingly technology-rich environment, educational leaders must be adept at influencing change in a way that is appropriate to the specific school population (including teachers, parents, and students). This includes developing a vision, which guides the school decision making process regarding the integration of technology. The effective educational leader must help the school community develop a set of guiding principles about the role of technology in the learning setting that is comprehensive and practical.

Access, Time, and Support: Inseparable Essentials

Not only must educational leaders provide the stimulus for meaningful change, but also they must be creators and sustainers of teaching and learning environments that are technology-rich. Particularly, they must be aware of inseparably related issues of access, time, and support.

Providing Adequate Access

Many schools are still wrestling with the question of whether to disperse computers in classrooms around the school or bank them in laboratories. This question is really a result of inadequate levels of access to computers. Few institutions have really addressed the question of what level of access is truly required for the successful integration of computers into the life of the school. Few educational leaders understand the importance of all the issues related to access.

The conventional definition of access focuses on the number of computers, the ratio of students per computer, and the amount of other technology in the school. This definition is too simplistic to meet the challenge presented when meaningfully integrating technology into classroom instruction (Office of Technology Assessment, 1995). An effective definition of access should also include the capabilities of the hardware in the school, the physical arrangement of technology in the building, and the existing systems of support related to the integration of technology (Office of Technology Assessment, 1995). And the definition must take into account the intended uses of the technology as articulated in the vision established for the learning environment. This more comprehensive definition of access would be more likely to guide sound decision making related to providing levels of technology that would better support its meaningful integration into the educational setting.

Providing Adequate Time

Workshops on the use of computers have, in general, proven to have only minimal value in promoting the use of computers by teachers. There are many reasons for this but one clear problem is the lack of time teachers have to sit down at a computer to try out the things they learn in workshops. The typical workday for teachers does not afford the luxury of sitting down at a computer to learn how to use it. Educational leaders must understand and find solutions to the problems related to time.

Providing Adequate Support

Computers and computer networks don't always work properly, but few schools have someone who knows how to keep things running smoothly. In addition, experience has shown that, in order to develop effective integration of computer technologies into their classrooms, teachers need to have access to someone who knows the technology and understands the learning environment. Personnel costs are the largest part of any school system budget. Little flexibility is usually afforded administrators in developing new positions or realigning existing positions. Some of the most critical decisions regarding the successful incorporation of technology into the learning environment can revolve around the educational leader's understanding of the need for support and how to develop that support system.

Because they are limited to physical placement and acquisition of equipment, Maddox (1991) identified current efforts to integrate computer technology as potentially harmful to meaningful technology integration. He identifies three conditions necessary to allow success in meaningful integration of technology in schools: availability of excellent software in all content areas; sufficient access to computers and necessary hardware in individual classrooms; and teacher interest and expertise in educational computing.

The first condition, appropriate software, is a challenge for schools. The Office of Technology Assessment (1988) reports that the quantity of educational software has improved, but quality issues still remain, with much of what is available having programming and technical problems. In addition, schools are further limited in access to excellent software because of the disparity across subject areas, and the lack of software that encourages higher-level cognitive skills. In fact, the majority of available educational software focuses on lower-level skill development in drill and practice and tutorial type software programs.

Availability of computers and necessary hardware in individual classrooms is another condition to be met for meaningful computer technology integration. Maddox (1991) describes current views of computer integration as merely dispersing computers from school computer labs into individual classrooms. Instead, computer labs should be viewed as an important and necessary part of school-wide computer integration. Computer labs offer an environment in which group computer instruction can occur both for students and teachers. By dispersing lab computers into classrooms, access and time for students could be further limited. Improved efforts towards classroom integration would include the placement of computers in classrooms in addition to maintaining existing computer lab environments.

The third condition, teacher interest and expertise in educational computing, must be met in order to integrate

computer technology appropriately into classroom practice. The Office of Technology Assessment (1988) concluded in a study that the lack of teacher computer expertise produces the most significant threat to the potential of schools to integrate computer technology into classroom instruction in a meaningful way. Teacher expertise will continue to be limited as long as staff development efforts continue to be driven by efforts to increase proficiency in only particular types of software. This practice prevents an increase in teacher self- efficacy related to computer technology.

In order for teacher expertise to increase, training must focus on increasing computer knowledge, not computer experience on specific software programs. Reinen and Plomp (1993) studied staff development and computer integration and concluded that appropriate staff development in computer technology may be the single most influential contributor to computer integration in classroom practice. Teachers identified in this study as exemplary computer-using teachers tended to come from school districts that invested heavily in computer technology staff development. Reinen and Plomp (1993) indicate that staff development topics related to pedagogical/instructional aspects seem to offer the greatest contribution to the integration of computers in the classroom. Pedagogical/ instructional topics include applications, program analysis, programming, and hardware/software knowledge (Reinen & Plomp, 1993).

Three areas of support must complement a comprehensive technology-rich environment: professional, instructional, and technical. Each of these dimensions of support is paramount if technology is to be implemented and used in an effective manner. However, that is not to say that each function needs to be the responsibility of a different person. Often, these functions may overlap and may be administered by one person on the building level. Some duties may be shared by a position that attends to several school sites. The danger in combining these functions is that a single person will have so many responsibilities, none of them will be performed well.

Support is an issue that must be addressed in the technology plan from its conception. Once a plan is in place, it may be too late due mainly to its costs in relation to the one-time investments in much of the plan.

An analogy which describes computer technology as a tool of instruction may be helpful in defining access, time, and support (Maddox, 1991). In contrasting computer integration and handwriting instruction, an example of an instructional tool that is eventually integrated across all subject areas would emerge. We would not approach handwriting simply by placing a pencil in each classroom and expect integration to occur in a meaningful way. Instead, we invest in instructional materials, devote an amount of time each day to instruction, and periodically evaluate progress. Once students develop basic skills, this intensive instruction ends and activity is integrated into the instruction of all subjects. Remediation is provided when necessary. If we also approach computer integration in this way, issues of access, time, and support seem clearer.

Decisions we make about computer integration should not always be limited to placing more computers in every school or classroom. As computer basics are acquired, computer technology could be integrated across subject areas. The important point in all of this is that integration will not occur without an increase in student and teacher expertise.

The Role of Assessment

Existing assessments, to which teachers are held accountable, do not address the types of learning and progress that students using computers make. Understanding that discrepancy and directions that can be taken to reduce the discrepancy become an important element in being an effective educational leader.

In order to assess the impact technology integration has on student outcomes, teacher instructional practices, and administrative organization practices; informal and formal data should be collected from multiple sources. The goal of this assessment and evaluation model is to determine which technology integration models or approaches will best serve schools. Such a determination can be made by creating an understanding the role of assessment in educational technology integration, matching goals and objectives to assessment measures, and creating possible effective integration models from the data collected.

Understanding the Role of Assessment

The assessment process is to be used to guide teachers' and administrators' infusion of technology into their daily school environment. The assessment should mirror the School Technology Commissions' recommendations that expected results of technology in the school environment to increase student learning, workforce readiness, teacher productivity, and cost effectiveness. In addition, the assessment and evaluation information should identify areas on which to focus professional development.

Matching Goals and Objectives to Assessment Measures

In order to match the School Technology Commissions' recommendations with the objective of expanding teachers' and administrators' understanding of both new technology and new teaching techniques, several quantitative and qualitative evaluation methods must be employed. One possible route to match goals to assessment measures is to take strands of student, teacher, and administrator technology practices and apply them to a model of computer use in schools. Such a model matches the relationship between student technology interaction and student cognition. Simply, in the assessment process we match the level of computer interaction to the level of cognition. When this

model is applied, we must consider the role of the student, teacher, and administrator (Makrakis, 1988).

Possible Models and Approaches

According to the three major achievement test publishers, true student performance-based tests are non-existent. At best, the evaluation process can capture student attitudes toward technology and students' interaction with technology as a learning tool. Conducting interviews with student focus groups can be an effective way to collect information regarding meaningful student interaction with technology across the curriculum. Affective instruments, designed to determine attitudes toward technology, may identify the effectiveness of current classroom technology practices to increase students' comfort with computer technology. The Educational and Psychological Measurement's "Computer Attitude Scale" may be used for students, teachers, and administrators (Bannon, 1985). Other attitude surveys include the Estes Attitude Scales (1987) and the Shaver Attitudes toward Writing with the Computer Scale (1990).

While attitude questionnaires may be employed with students, teachers, and administrators, most systems will seek a more achievement-oriented approach. The Macmillan/McGraw Hill Curriculum Frameworks Assessment test includes basic core curriculum subjects and mathematics technology. While costly, these batteries of tests provide schools with quantitative scores to match to attitude questionnaire outcomes, and student focus group outcomes. Only by webbing these multiple assessment approaches may schools create a learning environment that fosters access, time, and support.

Conclusion

Work with administrators in K-12 schools and with students in educational administration programs have shown that none of these issues of vision, time, access, support, and assessment is clearly understood by decision-makers. Many educational leaders are struggling with what they need to know personally about technology and with ways to support the efforts of their teachers and staff to incorporate that technology into the learning environment. Few educational leaders are users of the technology themselves, and even fewer have had training in their preparation programs or as part of professional development efforts to deal with the larger issues that are introduced when computer technology is brought into their domain. Just as we attempt to discover the best means through which to train classroom teachers in the effective uses of technology in their curriculum, we also must explore the skills, attitude, and knowledge an educational leader needs to be successful in a technology-rich environment. What training and experiences will lead to leadership practices that adequately support teachers as they integrate technology? What support do educational leaders need as they make the effort to bring technology integration into their schools?

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Distance Technology Enhances Educational Leadership for a National Values Project

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A national study conducted by Phi Delta Kappa International resulted in the identification of seven core values which U.S. Citizens agree should be taught by schools. The findings of this study have encouraged Phi Delta Kappa to sponsor a research and support system for educational leaders. As advocates of the national values project, Phi Delta Kappa has developed the League of Values-Driven Schools. The mission of the League of Values-Driven Schools is to encourage the centrality of values in the curriculum, structure, and administration of the twenty-first century school. The league is not a product or curriculum, but a network which encourages and supports research and instruction in the core values. Phi Delta Kappa believes that schools must graduate students who espouse the seven core values: learning, honesty, cooperation, service, freedom, responsibility, and civility.

Planning for the Future

The University of Texas at El Paso Chapter of Phi Delta Kappa believes that in the twenty-first century, the educated person must be able to:

- deal in an ethical manner with complex challenges and dilemmas new to the human condition
- apply sophisticated knowledge and skills to daily living and occupational tasks
- function successfully in a technologically complex environment

UTEP's Phi Delta Kappa also believes that, in the near future, schools and universities will be driven by the knowledge and skill assets of the institution. In effect, educational institutions will be highly varied and specialized, and knowledge will become the currency of professional and personal success. Thus, educational institutions must develop a focus and mission based on values and ethics rather than on content. Institutions must mentor students while they obtain knowledge and skills via the most effective medium and agency. Learning experiences will not be limited to conventional instruction, but will include opportunities to utilize such innovations as distance learning, Internet activities, and field studies. Coursework and activities will be available from worldwide educational resources. Students must be provided with opportunities to dialogue with others across the globe. Technological advances have presented new challenges and advantages for leadership and research. Brownell (1997) notes, that content of educational technology has changed from hardware and programming to the use of technology to enhance leanning and teaching.

Using Technology to Enhance Educational & Professional Studies

Students in the masters and doctoral programs in Educational Leadership at the University of Texas at El Paso have been offered the opportunity to participate actively in the Phi Delta Kappa national values project. These students can engage in action research as they:

- develop activities and ideas for circulation to league participants via the Phi Delta Kappa-UTEP website
- further investigate the core values for purposes of their own research, instruction, or professional development
- collaborate with other educators within the El Paso area, building networks across school districts and campuses

The League of Values-Driven Schools

The findings of this study have encouraged Phi Delta Kappa to sponsor a research and support system for educational leaders. As advocates of the national values project, Phi Delta Kappa has developed the League of Values-Driven Schools. The mission of the League of Values-Driven Schools is to encourage the centrality of values in the curriculum, structure, and administration of the twenty-first century school. The league is not a product or curriculum, but a network which encourages and supports research and instruction in the core values.

Project Expectations and Challenges for Participants

The purpose of the network is to make available learning ideas and opportunities to participants, with ideas originating in the activities pioneered by league members and others. The ideas and activities generated to foster the

seven core values will be shared via the UTEP / Phi Delta Kappa website, networking sessions sponsored by the UTEP Chapter of Phi Delta Kappa, and interactions among administrators, teachers, and students.

The Phi Delta Kappa project offers many opportunities to utilize and enhance educational leadership as participants move beyond traditional roles exercising leadership in the transformation as leadership becomes an intellectual process of 'reimagining' the learning environment (Sergiovanni, 1993).

In addition, the increased opportunities to conduct action research by utilizing distance technology via the website, e-mail, and the Internet enhance interaction and benefit all involved. Technology supports research efforts because it provides educators with devices for retrieving, storing, and processing great amounts of data (Webb, Montello, & Norton, 1994).

In the Phi Delta Kappa values project, participants at three collaborative levels, students, teachers, and principals, begin to build a community in which:

- learning and teaching encompass specific objectives (the 7 core values),
- learning and teaching are continuous for all participants (collaboration / networking),
- leadership roles are not limited to a given group (only administrators / only teachers)
- activities and conversations are not limited to classroom or campus levels (distance technology provides the means for universal communication)

The alignment of research efforts from the local to regional to state to national to international to forums would strengthen the support for the League of Values-Driven Schools and increase the knowledge base underpinning the seven core values (providing activities, ideas, discussions, etc.).

Problems Confronting Implementation

Time. At the beginning of this project, most of the high school student participants will have to dedicate time outside their normal schedule in order to participate. As the values project proceeds, the hope is that it will become embedded into the high school curricula so that it can be further developed during class time. It is anticipated that many university-level students will incorporate their values research into individual class assignments and into their theses and dissertations. It is also anticipated that teachers and professors will eventually follow the same path as students in this regard.

The time commitment for principals will probably always fall into the "extra assignment" category. However, the concept of everyone becoming a learner in the "community of learners" espoused by Roland Barth (1990), and by many other authors in the area of restructuring or reinventing schools, becomes reality for principals of league schools as they immerse themselves in their campus values research projects.

Logistics. The notion of local campus-to-campus collaborations presents formidable organizational, research, and communication problems which seem to shrink when compared to the problem of coordinating collaborative research efforts on a nationwide basis. But for distance education on Internet web sites and for e-mail, most efforts of this scope would soon fail. The reality is that the phenomenon of asynchronous distance education and research on the world wide web will facilitate the progress and success of the values league. The leadership of university graduate students acting as catalysts and facilitators for research and as mentors for high school project teams will also help to resolve some of the logistical nightmares. Sharing failures as well as successes on web sites as soon as they are known, then following up with e-mail discussions will help many project teams to avoid reproducing failure and allow them to adopt winning strategies already applied by teams throughout the country.

Summary

The League of Values-Driven Schools promises to provide challenges for every level of leadership in schools and universities, especially for students, teachers and professors, and administrators whose campuses are involved. The electronic medium known as the "Internet" has provided the forum through which a project of this scope and dispersion can be carried on successfully. Asynchronous distance education has also leveled the playing field by distributing leadership roles throughout all ranges of participant — student, teacher, and administrator, affording all the opportunity to become meaningful contributors to their individual learning communities and to the amalgam of values learning communities throughout the nation.

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The Need to Train Teachers to Use and Integrate Technology in the Classroom

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An attempt was made to survey a random sampling of elementary, middle school, and high school principals in Rhode Island and Southeastern Massachusetts. A listing of such principals was obtained from the Rhode Island and Massachusetts Departments of Education. Through this listing 266 principals were identified. These principals composed the survey group. One hundred eighty-seven principals responded to the survey. This is a response rate of 70.3%.

A two page questionnaire was designed by the Principal Investigators to gather information concerning the following: the availability of computers in the classroom, the availability of computer labs in the individual school, the number of computers available to teachers and students in each school, and the percentage of computer literate teachers and veteran teachers. In addition the survey instrument gathered information on how teacher preparation programs assist in better preparing pre-service teachers in computer technology and in determining the types of future in-service training programs colleges and universities could offer to better assist local school staffs in computer technology.

A pilot test was conducted on a sub-sample of the final sample population in September of 1996 and the data from this group was included in the final analysis. The purpose of this pilot was to determine if mailing procedures were adequate, and to check branching techniques as well as to alter response categories where needed.

Envelopes containing the survey instrument and a self addressed stamped envelopes were prepared using a computer generated mail labeling system by one work study student supervised by the principal investigators. The initial mailing of the instruments took place on October 11, 1996. The return questionnaires were organized as they arrived back at the education office on a daily basis by the work study student assigned to the project who gave them to the investigators. They were placed into a numerically sequential file according to respondent ID number. The ID number was then checked off in a code book and the date of return was entered. This not only allowed for a system of cataloguing of the returned questionnaires but also provided for a listing of all ID number for unreturned questionnaires. A final date of December 8, 1996 was set for accepting returned instruments so that analysis of the data could begin after the college's Christmas break.

Coding of the instruments took place on a daily basis and was handled by the principal investigators and one work study student. Check coding was done by the principal investigators. Standard columnar pads were used to tabulate the responses. Analysis of the data was done by the three people, the principal investigators and one graduate research assistant.

A computer technology survey was sent to 266 principals of secondary, middle and elementary schools in Southeastern Massachusetts and Rhode Island. One hundred eighty-seven principals responded to this survey. The survey asked questions relating to the availability of computers in schools and the amount of in-service training in technology available to teachers. A third aspect of the survey related to the training in technology necessary for pre-service teachers.

One hundred-one (54%) of the principals responding indicated that computers were available in every classroom in their school. Of the other respondents 44.4% indicated that computers were not available in every classroom. There were three respondents (1.6%) who left this item blank.

When asked if there was a separate computer lab in their school, 114 respondents (61%) indicated that there was, while 72 respondents (38.5%) indicated that there was not a computer lab in their school. One respondent left this item blank.

The next item on their survey was one in which the principals were asked to indicate the percent of teachers in their schools who were computer literate. Only nine respondents (4.8%) indicated that 100% of their teachers were computer literate; 49 respondents (26.2%) indicated that 75-99% of their teachers were computer literate; 61 respondents (32.6%) indicated that 50-74% of their teachers were computer literate; 65 respondents (34.8%) indicated that less than 50% were computer literate (See Table 1.)

Table 1.
Percent of Teachers Considered Computer Literate By Principals

Computer Literate Teachers in Schools	Number of Principals Responding	Percent of Principals Responding
100%	9	4.8%
75-99%	49	26.2%
50-74%	61	32.6%
<50%	65	34.8%
Blank	3	1.6%
Total	187	100%

Item five in the survey asked the principals responding whether they were computer literate. Of the 187 respondents 149 (79.7%) indicated that they were computer literate while 37 (19.8%) indicated that they were not computer literate. There was one survey on which there was no response to this item.

The sixth item in the survey asked whether the school system had provided in-service training in computer technology for teachers. There were 155 (82.9%) positive responses to this item with 30 (16%) negative responses and two surveys with no responses to this item.

Item seven asked the principals to indicate how extensive the in-service training in computer technology has been. Results are found in Table 2.

Table 2.
Frequency of In-Service Training In Computer Technology

Number of Frequency	Respondents	Percent of Respondents
Once a year	49	26.2%
Twice a year	39	20.9%
Quarterly	36	19.3%
Monthly	14	7.5%
Weekly	12	6.4%
Blank	36*	19.3%
Total	186**	99.6%**

The investigators doing this research feel that the large numbers of blanks is due to the fact that there has been no in-service in computer technology in these schools. In retrospect there is a feeling that another column "never" should have been included in the frequencies listed for this item.

***The one respondent not listed above indicated that there had been no in-service training since 1990.*

The next item related to whether there were plans to conduct in-service computer training this year. Thirty-four (18.2%) respondents indicated that there were plans for in-service training in computer technology this year. Thirty-two (17.1%) respondents indicated that there were no plans for in-service training in computer technologies this year. There were 120 (64.2%) blanks and one respondent indicated "maybe."

Item nine on the survey asked whether principals felt that more recently trained teachers (less than three years experience) had more familiarity with computers than veteran teachers. Of the respondents 112 (59.9%) answered yes, 62 (33.2%) answered no, and there were 13 (6.9%) blanks.

In the final area of the survey respondents were asked to respond to two open ended questions. The first question inquired how teacher preparation programs might assist principals in better preparing pre-service training programs with computer technology. The second question related to how local colleges and universities could offer to better assist principals and staff with computer technology training.

In response to the first question many principals took a personal and concerned response. Several themes appeared. Many felt that teachers need to be given fear-free training in which they could express their lack of or budding knowledge with and about computers freely. They felt this was needed as many teachers were afraid to use the computers and were reluctant to sign up for computer training because they felt that their lack of knowledge would be viewed in a derogatory manner. This response lead many to believe that training should be matched to the participant's level of knowledge and it should include instruction for those with no prior computer knowledge. Others felt that training in computer use should be mandatory for teacher certification.

Further, many note that although most teachers were familiar with computer basics, a lot of teachers were not knowledgeable about available software or how to match their required curriculums to computer based class work. Principals felt strongly that pre-service teachers should be exposed to the latest software and that software use should be mandated in their pre-service course work.

On a rather dim note to this question many principals said that training and software were not as great of a concern in their towns for they just didn't have the computers available. These people felt strongly that every teacher needed a computer and teachers needed to be trained to make informed decisions about what to buy.

In response to what type of in-service training colleges and universities could provide to schools, principals overwhelmingly wanted in-house training to tie the curriculum to technology. Many said these courses should be inexpensive and provide college credit. They felt that the Internet training, software reviews, and subject specific and writing programs should be covered. Others felt the it was important to have various levels of short and frequent courses with a menu of offerings. Repeatedly principals said these sessions should match the computer use to curriculum demand (e.g., Teacher e-mailing to Spanish classes so that

students could e-mail students in other countries that speak Spanish).They felt that this training should include long range computer planning (with updated consultation) as needed, should range from basic to advanced and overall be embarrassment free.

Many cited a need for help in trouble shooting such as having someone available to fix computers as well as to advise them on what to do when they meet program glitches. Finally many wanted college based regional teacher training centers established which would provide computer labs for large group training and workshops in class modeling, peer coaching, software and better pre-service.

It was obvious from the responses that these dedicated principals felt that this training was needed and that it was basic to their teachers' and students' needs for remaining current.

These results and conclusions for this study indicate that many teachers are not computer literate, that in-service training in computer technology occurs on an irregular basis in school districts, and that veteran teachers are not as familiar with using computers as newer teachers are.

These findings indicate that there are three basic needs. One is a need for training in computer technology in each education course in a teacher training program. Teachers, new to the field, need an extensive background in the use of the latest technology. They need to be able to search the Internet and develop materials for their classes from the Internet. They need to be able to show their students how to use the Internet.

The second need relates to veteran teachers in a school system. These teachers need to receive extensive training in how to best use the computer in their classrooms as a part of their professional development training. They need to receive training which will build their confidence so that they can become capable of dealing with available technology.

The third need relates to training principals of elementary, middle, and secondary schools to become competent in the uses of technology. This competency should be developed in preparation programs for administrators. For those already in school administration professional development training should be available.

Principals and teachers, new and veteran, should be comfortable in using the latest technology. They need to have continuous training so that they are up to date with the latest technology. If we are willing to provide this training the future will be bright.

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Implementing a Collaborative and Networking Technology Group: The Early Adopters

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Peer learning has been suggested by many as an innovative way to transform students' learning experiences (Blumenfeld, Marx, Soloway & Krajcik, 1996). Networking groups provide for a more developmental approach to learning by allowing members to voice their opinions and give input by building commitment to the group rather than to a particular activity and by encouraging more personal and professional involvement in constructing their own learning (Lieberman, 1996). Cooperative learning groups that engage members in the construction of knowledge will help advance the acquisition of disciplinary skills and understanding (Brown, 1995).

Peer learning and collaboration can be a powerful tool (Blumenfel, Marx, Soloway & Krajcik, 1996). Graduate students in the Curriculum and Instructional Technology program at Iowa State University saw a need for an opportunity to incorporate the skills and concepts acquired in their coursework. The result was a collaboration and peer networking group: The Early Adopters (TEA).

The Early Adopters solicit and complete intructional technology and other related professional projects for faculty, staff, and other graduate students within the Iowa State University, College of Education. This is accomplished through real-world projects supplied by faculty, staff, and group members. This paper will discuss implementation of The Early Adopters group, mission and goals, organization, benefits, and examples of current projects.

The Early Adopters group was implemented by a core group of graduate students interested in achieving a collaborative and interactive peer networking group. The name The Early Adopters comes from Everett Rogers' Diffusion of Innovations. The Diffusion of Innovations Theory consists of several categories of adoption of new technologies. Early adopters are considered to be the advisor or role model for the average innovators. The best way to alleviate uncertainty of adoption is for the early adopter to use it and share the results of its use. We are The Early Adopters, because we want to provide innovative atmosphere for the growth of ourselves and the college community.

In creating the group, the first agenda item was to consider the purpose and how to sell to the faculty, adminstration, and graduate students. This broad agenda item included expectations, membership, meetings times, project collection, project completion, organization, and financial support for the group's projects. The College of Education had already established a strong committment to an undergraduate technology group, The Educational Computing Club (TECC). TECC was formed as a traditional club with membership dues and the like. TEA did not want to work in a traditional club format, but wanted to focus more on collaboration and peer networking. Membership dues are not collected; financial support of projects come from grants or the Center for Technology in Learning and Teaching, which is located within the College of Education. Planning for the foundation of TEA was achieved in a six month time frame. At that time, TEA sought and gained support from Curriculum and Instructional Technology faculty by communicating with them the mission and goals of TEA. This past fall, TEA gave a presentation at a Curriculum and Instructional Technology seminar for graduate students. This enabled TEA to promote membership and reinforce our existence. With foundation work established, TEA now sought projects from faculty, staff, and graduate students.

The goal of The Early Adopters is to share and enhance graduate students and the graduate college community's technical and professional knowledge in the the field of Instructional Technology. Our underlining theme is as students converse and share knowledge they are exposed to and draw upon the expertise of others and learn from them. The founding members of TEA determined that the organization and leadership of the group would be based on a team concept with collaboration as the key component.; therefore,

TEA does not believe in enforcing a hierarchial approach to management . This approach allows students to incorporate their technical skills in multimedia, web page design, video and audio production, photography, and other traditional instructional media with current theories of instructional design and learning and gain real experience in research, grant and proposal writing, and project management. In addition, group members' commitment to the network, personal and professional associations, and visions of possibilities for change is strengthened. This provides numerous opportunities for leadership to emerge.

To keep TEA alive and visible, the following positions were implemented: chair, vice chair, secretary, historian, and treasurer. TEA also has experienced advisors who guide and oversee projects. These advisors are technical, grant, and project advisors. The positions were democratically chosen and filled through the same process. These positions are for communicating to members and interested parties. It is important to note that the members initiate and guide TEA; not the above noted positions. We are interested in a group effort and not individuals. To aid in the formation of "work" groups for selected projects, members are asked to fill out a proficiency sheet. Members rate their understanding and ability in several venues ranging from programming to grant writing to video production to web design. TEA does not limit itself to traditional mediums, but wants to provide a variety of opportunities for its members to grow professionally.

Therefore the primary motivation of TEA is to urge graduate students to take ownership and responsibility for their learning through peer interaction. A second motivation was for the students to gain practical experience in an instructional medium that is becoming more prevalently used. McInerney found, along with Wilkes and Byron (1991), that a cooperative learning format made possible a kind of discovery learning and interactive, experimental education that is very appropriate for adult learners who appreciate the opportunity to direct their own learning. Students also benefited from the networking opportunities created by projects and involvement in a group activity.

With the beginning of a new group, TEA sought meaningful and manageable projects. After the first call for projects made by the group, TEA received several possiblities from faculty. One of the most prominent that TEA accepted to tackle was Section Editors for SITE Annual Proceedings. These projects have provided great opportunities for us to collaborate and to reinforce our mission and goals. Other projects that the group is currently working long-term on are:

- professional organization list: Enable students to contact professional organizations for membership, publication, and conferences.
- management of Project Opportunities' web page: Maintain and develop Project Opportunities' web page.
- electronic graduate survival kit: Give new graduate students information on forms to be completed, committe selection, and basic procedures in graduate life.
- Science and Technology Fair Presentation: Provide information to middle school and high school students on uses of technology.
- multimedia presentations

More and more, technology is changing how students gain access to information and how that information is presented. Computer-assisted learning environments such as the Internet, interactive laser discs, and CD-ROMs are becoming more prevalent in the educational world of today. Yet much of the effect that this has had has been to isolate students from each other and foster the development of asynchronous learning environments that are not unlike electronic correspondence courses. Cooperative learning is an important part of the educational experience that needs to be integrated into the instructional design of these new learning environments. These new technologies are going a long way toward fulfilling what Morariu (1988) called "the dream of creating information-rich, learner-directed instructional environments" (p. 17). Yet, TEA affords the opportunity to continue group work and lessen the opportunity of isolation. The Early Adopters intends to lead Iowa State University, College of Education into the future of Instructional Technology.

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ADMINISTRATORS INTEGRATING TECHNOLOGY WITH A PERFORMANCE-BASED ASSESSMENT MODEL

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In this paper, we present a performance-based assessment model designed to measure the impact technology makes on student achievement in the four domains tested on the North Carolina Technology Performance Test. These four domains consists of keyboarding techniques, word processing and editing, database use, and spreadsheet use. As part of this research, a model of qualitative and quantitative evaluations are presented to enable public school administrators, public school teachers, and university/college professors to establish curriculum environments in which students control technology's interaction with the real world. Our research is based on the School Technology Commissions' recommendations that expected results should impact student learning, workforce readiness, teacher productivity, and cost-effectiveness. Further research implications are based from Martinez and Mead's 1988 "First National Assessment," which provided a comprehensive list of recommendations on the topic of computer competence and implications for administrative practices.

We address these recommendations by developing professional development from performance-based assessment data. (This will enhance teacher productivity.), using a collaborative partnership to share resources, strategies, and evaluation reporting systems (This is cost-effective.), using technology in English-math-science courses that allows students to be interactive learners (This is student centered learning.), and establishing core-curriculum learning experiences that relate to work maturity skills and work transferable skills outlined in the School-to-Work Opportunities Act [STWOA] (This incorporates workforce readiness.).

The Research Participants

In North Carolina, all eight graders who fail the North Carolina Technology Assessment Test will retake the test in high school. Of the rural counties participating in this performance-based study 42.35% of their students will retake this test. This places the burden of student technology skill remediation at the high school level. It is not known to administrators or teachers if the 57.65% who did pass the test transfer or maintain these technology skills over a given time period. Three rural North Carolina public school systems, faculty members from one state university, and faculty members from a private historically minority college (Chowan College) formed the Rural Technology Challenge Partnership (RTCP) to address these problems. Collectively, these counties represent rural foothill, mountain, and sandhill geographic regions representative of the state.

The Research Project

The research and evaluation design employed will serve as the tools to combine performance-based assessment outcome scores with administrator professional development strategies designed by the partners (university, college, and public educators). In addition, these technologies will expand teachers and principals understanding of both new technology and new teaching techniques. Evaluators will report past technology scores (pre-test) in the Fall of 1997. From this information teachers and partnership members will plan curriculum integration and technology purchases (hardware and software) that are directed at impacting student ability to use technology as a learning tool in specified performance domains. Throughout the year students will be re-tested (post-test) and their findings reported. This quantitative data will be compared to qualitative analysis of teacher and student descriptive responses. Basically, the partnership believes rural administrators, teachers, and their university/college partners can successfully overcome student technology barriers if clear identifiable benchmarks are established.

Our plan recognizes three "Technology Development Stages" that target commonalties of our participating rural high schools. These technology development stages

consists of (a) a performance-based assessment model that measures students' mastery in four technology domains that can be impacted by alternative learning practices; (b) professional development tied to performance-based outcomes; (c) acquisition of technology equipment that supports professional development plans and needs identified in performance-based outcomes. Through these development stages technology and telecommunications strategies support a transformed teaching and learning environment. This approach is designed to enhance the transfer and maintained effect of technology performance-based assessment skills. If properly integrated into the curriculum, these technology development stages create a systematic approach to create a more equitable school environment.

Research (Cole & Griffen, 1987) reveals economically poor students spend their time on drill-and-practice exercises while better off economically students spend their time in more meaningful activities. It is the intention of the technology development stages to create a more equitable technological environment. This is accomplished by principals emphasizing professional training and acquisition of equipment based on students' needs found in performance-based outcomes. Historically, businesses match every dollar spent on hardware or software with a dollar spent on training and assessment (Sikula, Buttery, & Guyton, 1996). Statistically, educational organizations spend twenty-five cents on training and assessment for every dollar spent on hardware or software. Only through the leadership efforts of the principal can appropriate acquisition of equipment and staff training be established. We identify appropriate acquisition as the criteria set in "President Clinton's four national technology goals" which include the following: (a) all teachers will have training and support to help students learn using computers, (b) all teachers and students will have modern, multimedia computers in their classroom, (c) every classroom will be connected to the information highway, and (d) every software or on-line learning resource will be part of the curriculum.

The model established to augment these four acquisition priorities combine performance-based assessment outcomes with the professional development guideline. By doing so, we promote the acquisition of technology on an expanded understanding of both new technology, new teaching techniques, and existing student learning outcomes. Our principals have established the following professional development and technology enhancement schedule.

1. Teachers meet in their core-curriculum groups for six days with university faculty. Prior to these meetings all stakeholders are briefed on student performance-based outcomes. Specific instructional strategies and practices are designed around assessment learning outcomes.
2. Teachers receive six days of instructional support through a combination of their principal, peer teacher, or college faculty members. This support allows strategies to be tested, promotes implementation, and allows team collaboration to remove obstacles.
3. Technology acquisition, teacher technology training, and in-school support plans are designed with the principal, teachers, and professional development facilitators. All participants use telecommunications to articulate strategies.
4. Principals at each of the participating high schools receive professional development in the areas of leadership and technology implementation. The goal of principals is to be lead facilitators and participants in the technology performance-based assessment model implementation plan.

Administrator's Integration Role

Wolf's 1993 research revealed that public school principals' use of technology is found in general administrative areas. These areas consisted of office administrative use, office word processing, budgets, and the maintenance of records. While the use of technology in these areas is beneficial for the administrators, it fails to support the impact principals can deliver to the school's technology climate. Writing on effective schools suggests that the principals can have a major impact on efforts to improve the organization and delivery of services to students (Bossert, Dwyer, Lee, & Rowan, 1982). If principals are to be effective technology leaders they must establish the framework and climate in which goals will be achieved (Wolf, 1993). We suggest that administrators must integrate technology climates that cause daily interactions between principals and teachers and/or principals and students.

These daily interactions are based on the four fundamental factors associated with successful technology integration. The four factors consists of national context, school organization, external support, and innovation characteristics (Fullan, Miles & Anderson, 1988; Van den Akker, Keursten & Plomp;, 1992). Note, one of the main reasons these for the failure of these four fundamental factors associated with successful technology integration is lack of support from school principals (Brummelhuis & Plomp, 1993). For the purpose of this paper we will relate these four integration factors to each integration stage contained in our statewide initiative.

The Performance-Based Model

Students

Technology integration into core curriculum classes creates three student learning outcomes. These outcomes consists of an achievement learning outcome, affective learning outcome, and a skill learning outcome. In order to gain a performance measure in these areas, the initiative

utilizes three instruments. First, the Iowa Achievement Test of Basic Skills is used to measure students' English and Math performance. Second, a questionnaire administered to students measures technology frequency interactions, attitude toward technology, and quality of those interactions. In addition, focus groups are held with students so descriptive data may be compared to affective questionnaires. Finally, the students are administered a personnel test containing basic employment skills.

Implications For Principals

As principals, the implications of technology integration is not found in what teachers do or what students experience. The implication of technology integration is found in what measurable conceptual and skills relative to computers can students demonstrate (Anderson & Collis, 1993). In short, these are the exact outcomes principals are accountable for by their constituents.

The normal school day is not conducive to teacher interaction or research planning needed to accommodate the integration of technology into the classroom. As a transformational leader, the principal must create bi-directional situation of research-technology integration and technology integration research to occur. In order to accomplish bi-directional situation, plus overcome rural isolation, teachers and principals employ telecommunications home through the use of Internet and e-mail. In each of our three counties principals took the lead in negotiating a more competitive on-line charge so more teachers could participate. Principals should be able to negotiate the cost of these home on-line hookups and cover the cost through professional development funds. The telecommunication link allows principals and teachers to communicate strategies via e-mail and download instructional materials. In addition, principals had their administrative staff participate; thus, placing the entire school in the bi-directional transformation.

The practice of principals using technology to communicate with teachers in this manner causes the school environment to rely on technology as an essential irreplaceable learning tool (Wark, 1997). In addition, the principal, with his or her teachers, change the culture of the school by altering the flow of information and communication. An example of this communication is illustrated in the methods that performance-based outcomes are used.

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CREATING A PARTNERSHIP TO ENHANCE TECHNOLOGY STAFF DEVELOPMENT

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There is a concern that without access to technology there will be no changes in students' learning (Grabe & Grabe, 1996). As schools become more technologically rich, teachers are lacking more of the skills necessary to benefit from new instructional capabilities. While teacher preparation programs are creating technologically prepared teachers, there must be appropriate staff development to get experienced teachers "up to speed" in the use of technology (Maurer & Davidson, 1998). Factors that have traditionally accounted for limiting the involvement of teachers using computers in the classroom have included: lack of time to plan, lack of teacher training, scheduling difficulties, and lack of available computers and software (Becker, 1991; Sheingold and Hadley, 1990).

The North Carolina Department of Public Instruction recently adopted teacher competencies for all school personnel requiring certification. The general goal for teacher competencies are to assist an educator in acquiring the knowledge and skills necessary to introduce students to the computer skills identified for all students. This will aid new teachers seeking licensure in North Carolina, but it does not address the need for staff development with teachers currently in North Carolina public schools.

In addition, computer skills are required for all students before high school graduation. The student computer skills curriculum focuses on "preparing the student to be an independent user of technology for personal and school needs" (NC Correlation Chart, 1993). The initial student testing is completed in the eighth grade. All eighth graders who fail the North Carolina Technology Assessment Test retake the test in high school. Thus, the majority of student technology skill remediation is completed at the high school level.

Purpose

The purpose of this study was to aid public school teachers in their development of technology skills and the integration of these skills into their content area classrooms. To accomplish this the Rural Technology Challenge Partnership Grant was secured from the state of North Carolina in three rural county school systems. These counties were chosen because 42.35% of their students had to retake the technology assessment test last year.

Universities can provide technological network assistance to schools in numerous ways. Access to a university computer network allows schools to connect to a vast system of resources. E-mail and other telecommunications systems can enhance communication among educators who are geographically dispersed. Cooperative grant writing can enable schools to appropriate needed hardware, software, and support (Zimmerman, Greene, Schlagal, Trathen, & Blanton, 1997). These necessary underpinnings for successful telecommunications use may be frequently found in partnership relations between public schools and universities. However, assistance in the application of technologies is far less common in practice than it should be. It is through shared activity that learning best occurs (Rogoff, 1994).

Connecting system-building components, evaluating, technical sharing, and creating technologically advanced high schools in the three counties was the responsibility of a team composed of public school and university faculties. This team collaboratively provided a systematic approach towards the creation of a technology implementation effort based on student needs found in performance-based outcomes. The approach during implementation of this model involved changes in each high school's use of technology and its relationships that impacted classroom instruction, policy-making, collaboration with existing initiatives, and leadership functions.

Project Implementation

The partners (university and public educators) were contacted to create strategies to expand teachers' and principals' understanding of both new technology and teaching techniques. This team also worked directly with a curriculum specialist in technology and a technology specialist to explore software and implementation strategies. All participating teachers were given access to on-line resources in their classrooms. In addition, all partners in the public schools and universities were loaned identical laptop computers for ease of interaction and teaching.

Before this study began, participating teachers completed a questionnaire listing demographics, technological proficiencies, current uses of technology, attitudes and hindrances to usage of technology.

Methodology

Student Qualitative Evaluation: Students' descriptive responses were collected in each English class (grades 9-11) as part of an integrated technology-English composition assignment. They were asked to construct a five-paragraph essay to describe the integration of technology in their learning experiences. Descriptive responses were collected from all three partnership counties.

Teacher Qualitative Evaluation: Core curriculum teachers (English, math, science) were asked to complete an open-ended questionnaire at the end of the school year to reveal current strategies they used in integrating technology in their classrooms.

Quantitative Evaluation Design: The North Carolina Test of Computer Skills (Performance Part) was administered to all students grades 9-11. This part of the test consisted of four domains: keyboarding techniques, word processing/ editing, database use, and spreadsheet use. Individual student scores were reported in each of the four domains. An analysis of covariance was used to correlate the individual student scores with cohorts of classes.

Results

When the participating teachers were surveyed on current uses of technology and availability several facts came to light. There were computers in all classrooms. The number of these ranged from 1 to 30 per classroom. There were computer labs in both participating schools. All teachers reported a lack of telecommunications options. Computer training had be received through self-teaching and workshops. All teachers were currently using word processing, data bases, and spreadsheets within their classrooms. E-mail was used by one-third of the teachers. All teachers, except for one, supported the use of technology to support curriculum, increase subject-specific knowledge, design and manage learning environments and resources, address diversity among students, and in ways that are appropriate socially, legally, and ethically. One teacher responded that he thought the technology should only be used to address diversity among students. Limited access to equipment, limited time, and lack of modem/ telephone lines were the top three hindrances listed to the usage of technology.

Teachers requested further information and training to use technology in alternative ways than they had experienced. Their immediate concern was that in math and English courses the researchers would discuss spreadsheets and word processing. They also initially requested software catalogs and funding thinking that the Internet had little value to their teaching. After extensive sessions and training, the researchers were able to convince teachers to integrate Internet searches, web authoring, World Wide Web boards, and video-conferencing into their lesson planning. Teachers were also linked together on a listserv to provide a community of educators to share cultural experiences, write to an audience, and make comparisons about teaching, learning, and schools. Teachers were able to communicate with each other about issues that affect all of them.

The team provided partnership schools with four components: 1) county level technology performance-based assessment, 2) professional development opportunities that link performance-based outcomes with the North Carolina Standard Course of Study, and 3) technology resources.

Implications

Only a portion of the data from this study has been archived and analyzed. Individual self reports suggest that the process is on target for completing its goals. Additional benefits of this project may be seen in a comparison of partnership counties with comparable children in other counties. A community of learners using technology has been created. Funding has been provided for an additional four years and careful examination and adaptations of this project are currently being made. The direct value of this community to teaching practices and to individual student achievement needs further assessment.

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FACULTY DEVELOPMENT

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Given the emphasis on using technology in education to impact student learning, teacher education programs must prepare teachers who can design learning environments where K-12 students are actively involved in the purposeful use and integration of technology for learning tasks. Because of technology's potential as a cognitive learning tool, it is assumed and expected by many that teacher education faculty will learn about and use various technologies in the preparation of teachers. Although most teacher education faculty indicate that technology is important, they still do not feel comfortable using technology with students (U. S. Congress, 1995).

There are many barriers that confront teacher educators in their attempts to use technology. Common barriers listed by College of Education faculty include "time, limited resources, faculty comfort level and attitudes, and little institutional encouragement for technology use" (U.S. Congress, 1995, p. 187). Even though these barriers are difficult to address, many teacher preparation institutions are seeing the need to overcome them and are beginning to provide professional development opportunities for faculty. Hence, Colleges of Education are designing staff development programs that provide support for faculty as they learn about using technology in the preparation of teachers.

The papers included in this section describe a variety of innovative models and unique initiatives that have been designed and implemented to improve the use and integration of technology at colleges and universities. Collectively, these papers describe the specific processes that several institutions have taken to improve the use and integration of technology by faculty and students, but separately the papers document the unique approaches that each institution has implemented to meet the challenge of technology integration. Rather than categorizing these papers into subgroups within various faculty development themes, I have chosen to summarize each paper to highlight the individual and unique approach the authors have taken to address the faculty development issue as it pertains to technology at their institutions.

Two professional organizations, The International Society for Technology in Education (ISTE) and National Council for the Accreditation of Teacher Education (NCATE), have both identified as part of their organizational standards technology skills that teachers are expected to have when they enter the teaching field. Handler, Strudler, and Falba describe a planning model that will assist faculty with the identification of ISTE standards that can be applied to the specific courses they teach. The authors will offer strategies faculty can use to model the effective use and integration of technology for instruction using the ISTE standards. This model's framework places emphasis on the articulation of technology integration between teacher education courses in the professional sequence.

Matthew, Parker and Wilkinson report the results of a research study based on the Stages of Concern model developed by Hall, George, & Rutherford (1997). In the Spring of 1996, faculty at Louisiana Tech University gained more access to technology and this study identified faculty concerns related to having access to these technologies in their offices and classrooms. As part of the study, faculty were to indicate what type of faculty development workshops would help them with using these technologies as personal productivity and instructional tools. These results will assist other Colleges of Education in determining the technology and staff development needs of the faculty and how those needs might be met by providing faculty a variety of staff development opportunities for faculty.

Woods, Peterson, Richardson, Davis and LeJeune describe their efforts to design a Web-based faculty development workshop. This dynamic, learning environment provided time for participants to reflect upon their teaching philosophies and practice, while using the World Wide Web to share their ideas with others. Findings from this pilot study, indicate that a Web-based staff development framework has promising applications for a broader audience that might include K-12 teachers and media specialists.

In the Faculty Computer Use Project at Buffalo State College, Stevens and Lonberger describe their project that focuses on three major themes; access, training and context. All faculty who participate in the project are given access to

equipment in their office with the guarantee that upgrades will be provided in the future. The training component of the project was designed to meet the needs of the participants at their level of technology expertise. Lastly, and often ignored in technology integration models, faculty were given the opportunity to dialogue about and explore the contextual issues that confronts users of technology as well.

Similar to the Faculty Computer Use Project described above, one goal of the instructional technology training program at Moorhead State University is for faculty to utilize technology in ways that expand and enhance course objectives. Ficek characterizes this initiative as an instructional training program designed to accommodate different learning styles of faculty. Actual training opportunities for faculty are delivered in a variety of formats which include group training, cooperative teaching, department-specific training, and student/faculty mentorships. This design provides a variety of learning opportunities that will evolve to meet the ever-changing needs of the faculty involved.

At Eastern Kentucky University (EKU), the teacher education program is considered a function within the nine colleges at the university. Therefore, it was the goal at this institution to create a faculty development program that would meet the needs of the entire EKU learning community. Dickey and Davis document the process of creating a needs assessment which addresses faculty promotion themes such as instruction, scholarly activity, and service. Although the results indicated that faculty requested staff development opportunities in seven different categories, the category requested most by respondents was technology. To meet faculty needs, this model provided technology instruction in a variety of formats such as workshops, presentations, training sessions, satellite broadcasts and a two-day exposition.

With the establishment of the Office of Educational Technology (OET) at the University of Illinois Urbana-Champaign, faculty in the College of Education who are interested in using and integrating technology are supported by multiple means. Thurston, Stuve, Pianfetti and Thomas present a staff development model that supports faculty through co-teaching of technology strands in courses, individualized one-on-one faculty consulting, workshops and technical troubleshooting and repair. Unique to this model is the notion of integrating technology into several sections of the pre-service teacher education courses within a Year Long Program (YLP), rather than offering a semester long technology course. To support the initiatives of the Year Long Program, OET staff provide support to the course instructors, provide laptop computers for students, conduct workshops, and help co-teach the classes that involve the use and integration of technology. The OET's technical support component is one that can serve as a model for other institutions in their quest to effectively support faculty in their use of technology.

Carbone and Mitchell document the process of developing a training program designed to prepare postgraduate students for their role as educators. This training program at Monash University, which initially began in 1996, and has evolved into an effective tutor training program where the tutors and demonstrators focus on improving the quality of teaching and student learning. Currently, this tutor training program is used with students enrolled in computer science courses, but its approaches for conceptualizing teaching and learning could be applied to any educational situation.

Zhao, Rop, Banghart, Hou and Topper from Michigan State University provide readers with an interesting 'look' at two distinct cultures within technology and education. The authors refer to these two cultures as the 'techies' and the teachers. Documented in this paper are narratives from four techguides who were involved in the attempt to create a culture where 'techies' and teachers would interact and therefore establish a shared culture of teaching and learning with technology. The techguides' descriptions of their experiences offer us insight into the diverse nature of our background experiences and how these experiences effect our ability to learn from and share our knowledge with others.

The majority of faculty development models that have been described in the literature are those that involve staff development opportunities for faculty and students within the same teacher education program, college or university. Little-Reynolds and Takacs propose a model which involves the collaborative efforts between the faculty and graduate students at two different institutions (approximately 260 miles apart), as participants from both institutions assist each other with technology integration efforts at a distance. In the Collaborative Technology Integration (CTI) model, the faculty from Mary Washington College (MWC) and graduate students in instructional technology from West Virginia University (WVU) work collaboratively to identify effective uses of technology and to facilitate technology integration into courses. For the duration of the project, the participants communicated with each other by the use of email, faxes, and the telephone. Two of the participants in the program offer their reactions to the successes and limitations of the project. As this model illustrates, educators and students are no longer confined to a room or a building to access support for technology integration.

Providing access to the technology for faculty and students has been a priority for teacher education institutions in recent years and often is seen as one of the critical issues that impacts the successful use and integration of technology throughout teacher education programs. It seems, faculty, staff and students at Valley City State University (VCSU) solved the access barrier by implementing an innovative and comprehensive plan for institutional change that involves the distribution of notebook comput-

ers to all faculty and students. To support this initiative, the campus network connects all offices, residence halls and classrooms. In fact, all of the classrooms at VCSU have Internet access at each seat. Students graduating from VCSU will be required to create an electronic portfolio that will document and demonstrate their progress through the teacher education program.

Finally, Byers, Hoadley, Pike and Byers provide us with an update on the progress made by the Center for Instructional Design and Delivery (CIDD) at the University of South Dakota (USD) specifically, in their efforts for assisting faculty with the application of technology for professional activities. Each semester, at least twelve faculty members from across campus are given release time to participate in a semester long training program. Some of the requirements for the faculty involved in the CIDD program include serving as a liaison between CIDD and their academic units, attending CIDD training sessions, and assisting the CIDD with grant writing. This faculty development model illustrates the commitment and support required by the entire university community to incorporate technology into the learning and teaching process.

Collectively, these papers offer us a variety of models and approaches for assisting and supporting faculty, staff and students with technology use and integration throughout our college and university programs. Faculty development initiatives such as these can help us assemble communities of learners and teachers who are striving to design educational environments that use technology in powerful and compelling ways to impact learning.

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Supporting Faculty in Efforts to Integrate Technology into Teacher Education

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The recent report, *Teachers and Technology: Making the Connection*, (U.S. Congress, 1995), confirmed that "technology is not central to the teacher preparation experience in most colleges of education. Consequently, most new teachers graduate from teacher preparation institutions with limited knowledge of the ways technology can be used in their professional practice" (p. 165). According to the report, "Helping teachers use technology effectively may be the most important step to assuring that current and future investments in technology are realized" (p. 2). How, though, can we best prepare preservice teachers to develop the skills needed to incorporate a variety of technology tools in their professional practice? Most leaders in the field agree that this cannot be accomplished by educational technology classes alone. In addition to specialized courses in educational computing and technology, preservice teachers should experience widespread integration of technology into "non-technology" classes and field experiences; thus having opportunity to apply the skills gained in the educational computing class.

At the center of this problem is the need for university faculty to develop skills in the instructional use of technology tools; to model their use while teaching and to provide authentic experiences for the preservice student. We know from the work of Roberts and Ferris (1994) that it takes many hours for faculty to become comfortable with technology, let alone be ready to consider how to integrate these tools into their own teaching. Systematic approaches to achieving this type of technology integration, however, have been lacking. In the recent past, several outside driving forces have come into play and may move the use of technology in teacher education forward.

The movement among professional organizations is to develop standards that provide a framework of expectations. The International Society for Technology in Education (ISTE) has developed a series of standards for the field. We are concerned with the Foundation Standards; standards that recommended the skills all new teachers should have as they enter the field. The other influencing set of standards come from NCATE (1997), the accrediting body for colleges of education. This group has provided more emphasis on technology than it has in the past, but it has not yet included meeting the Foundation Standards as a part of the precondition report.

A New Model

We will describe the efforts made at two colleges of education to systematically address the needs indicated above. Specifically, it will focus on a planning model and supporting materials that address the Foundation Standards established by the International Society for Technology in Education, that all teachers should meet. The model provides a structure that can assist university faculty select where each of the standards could appropriately be applied in specific courses, identify technology tools that faculty could model and use in their own instruction, and specify experiences and particular software that would help preservice teachers plan lessons for use in their future classrooms. A key assumption of these materials is that the ISTE standards should be addressed in a systematic way that requires structured planning across courses and specialty areas. Handler and Strudler (1996) developed this framework, the materials, and strategies for their use. The model was piloted in two teacher training institutions; one a midwest private, the other a western public university. Despite these differences many similar experiences were encountered.

The paper session will describe the experiences, similar and different, that were encountered and the restraining forces that were met. It will conclude with recommendations for future efforts in this direction, including the impact of the now changed ISTE Foundation Standards.

The supporting materials developed for the model may be found on the CD for this conference.

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Faculty Adoption of Technology: Stages of Concern

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Multimedia, pentium computers with Windows95, Microsoft Office, and Internet access can be overwhelming for education faculty who are accustomed to using IBM PS2 Model 30-386 computers with 4MB RAM and 40MB harddrives with WordPerfect for DOS. Internet access was through huge, IBM mainframe terminals with blinking green cursors that repeatedly froze. In the past two years as new faculty were added, they received Pentium computers that lacked CD-ROM drives and sound cards, but did, however, have both 3.5" and 5.25" disk drives, or they received CD-ROM drives with no sound cards and 3.5" disk drives. Lack of technology and easy Internet access in the College has not kept all of the faculty from learning about and using technology. Some faculty have hiked across campus to the 10th floor of the library or to an engineering building to gain Internet access and to take faculty development courses on the Internet. Other faculty accessed the Internet through local service providers in their homes.

In the Spring of 1996, technology resources began to change when a technology grant was awarded and an accreditation visit from the National Council for Accreditation of Teacher Education (NCATE) was eminent. NCATE standards require that faculty be "knowledgeable about current practice related to the use of computers and technology and integrate them in their teaching and scholarship" (NCATE, 1995, p. 24). The Louisiana Board of Regents funded a technology grant that replaced the Apple IIe computer lab in the College of Education with a Macintosh computer lab. During Spring, 1997 university funds became available to wire the College for Internet access in offices, classrooms, and the Macintosh computer lab. Additionally, the Board of Regents funded a second technology grant that provided a networked statistics lab. Multimedia, pentium computers with Internet access were placed in faculty offices and networked laser printers were installed in Fall, 1997. Other grants provided for a technology-rich classroom, software, and peripherals, such as digital cameras. The state is funding a distance education classroom that will be installed in the College in Spring, 1998. The changes in the technology available in the College are having a profound impact on the faculty with their office computers having the most direct impact on them.

Faculty have very personal concerns about these changes which may be manifest as resistance to change. Resistance to change can be attributed to the following fears: 1) fear of change, 2) fear of time commitment, and 3) fear of appearing incompetent (Rutherford & Grana, 1995). Fear of change is evidenced by faculty members resisting relinquishing mainframe terminals, old computers, and old printers even though the new technology has been installed and they have been given personal instructions on its use. Fear of time commitment is manifest by faculty who indicate they would like to attend faculty workshops and enroll in faculty technology classes. However, they do not enroll in the classes because it takes so much time to learn to use technology, and because they have so many other things demanding their attention. Some faculty openly express their technological incompetence, others quietly whisper this fear, and others simply continue to avoid using technology. Faculty fears and concerns are affected by individual faculty personalities. Some faculty are willing to take risks, eager to learn new things, and flexible enough to cope with new technology. Other faculty are not.

Individual faculty convictions influence their willingness to adopt an innovation. This adoption usually involves a five stage process: 1) awareness of the innovation, 2) judgment of the value of the innovation, 3) decisions based on the judgment, 4) implementation, and 5) confirmation of the viability of the innovation based on personal decisions and in collaboration with others (Wells & Anderson, 1997). Faculty beliefs and experiences with the innovation impact their acceptance and use of the innovation. Only if they find the innovation personally relevant and of value to themselves will they use the innovation and explore ways to use the innovation with others. The acceptance of an innovation is highly personal and individual concerns about the innovation can hinder or even obstruct the change process (Linnell, 1994).

Innovation requires change, and a natural part of the change process is resistance. Resistance to technology integration in colleges of education is multifaceted (Roberts & Ferris, 1994; Cummings, 1996). Frequently encountered problems include: 1) lack of active support from the adminis-

tration, 2) inadequate hardware and software, 3) faculty who do not want to take risks and make commitments, and 4) inadequate, on-going faculty development. Fortunately, most of these problems have been resolved in the College. Support from the college administration is evidenced by their working to obtain the funding to provide hardware, software, and wiring for Internet access. They have also been supportive of faculty efforts to secure grants to provide additional technology resources. The willingness of faculty to take risks and make commitments is on a continuum. Some faculty members use technology for their personal benefit, integrate it into their classes, and work collaboratively to share their knowledge of technology (Parker, 1997). Some faculty members use technology for their own benefit, but do not teach with technology. Then, there are those faculty members who are not technology users. Last year with the upgrading of the College computer lab, faculty development technology workshops were offered each month and will be offered throughout the year. Further, faculty are provided individual, personal assistance and assistance with their classes in the computer lab when requested. Successful implementation of an innovation requires not just technical support, but also support that addresses the affective concerns of those instituting the change (Linnell, 1994).

The Stages of Concern Questionnaire assesses the intensity of concerns experienced as an innovation is adopted (Hall, George, & Rutherford, 1977). These concerns occur in a natural, developmental sequence marked by stages. Since movement through these stages is developmental, not everyone achieves all of the stages. These stages include: 1) awareness, 2) informational, 3) personal, 4) management, 5) consequence, 6) collaboration, and 7) refocusing. The first four stages focus on internal concerns of the individual, and the last three stages focus on external concerns relating to how the innovation may impact their associates and their students. The awareness stage is indicative of a knowledge of the innovation with little or no involvement with the innovation. Characteristic of the informational stage is a desire to learn more about the innovation with little concern for its impacts on the individual. The personal stage is characterized by knowledge that the innovation personally affects the individual accompanied by uncertainty as to the demands of the innovation, uncertainty as to the individual's ability to meet the demands, and uncertainty as to the individual's role with the innovation. At the management stage, the individual's concern is with the amount of time required to use the innovation effectively and efficiently. At the next stage of development, internal concerns shift to external concerns. The consequence stage involves focusing attention on the impact of the innovation beyond the individual. This stage is followed by collaboration which sees the individual focusing efforts on using the innovation in coordination and cooperation with others. The final stage of development is refocusing, whereby the individual focuses on other ways to benefit from the innovation and explores alternatives to the innovation. It is expected that movement through the stages leads to a decrease in internal concerns with a corresponding increase in external concerns related to the innovation.

The purpose of this study is to determine faculty concerns about the changes in technology in the College, specifically their office computers with Internet access. *The Stages of Concern About an Innovation Questionnaire* [SoCQ] (Hall, George, & Rutherford, 1977) is being used to assess faculty concerns. Three questions frame this research. At what stages are the faculty in their concerns about using their computers with Internet access? What impact will faculty development technology workshops and one-on-one assistance have on their stages of concern? What changes will occur in the faculty's stages of concern over time?

Methodology

Sample

The participants in this study are the 41 faculty members in the College of Education. Three departments constitute the College: 1)) Curriculum, Instruction and Leadership, 2) Psychology and Behavioral Science, and 3) Health and Physical Education.

Instruments

Two instruments are being used to gather data for this study: 1) Stages of Concern Questionnaire and 2) Faculty Development Technology Workshops Survey.

Stages of Concern Questionnaire. The SoCQ (Hall, George, & Rutherford, 1977) measures changes in concerns over time as an innovation is adopted. The questionnaire consists of 35 concerns based statements, five for each of the seven stages of concern assessed by the questionnaire. Responses to the statements are on a scale of 0 to 7 with 0 indicating a very low concern or irrelevant at the present time and 7 indicating a very high concern. The instructions direct the participants to indicate their present degree of concern for each statement. The original version of the questionnaire uses the word innovation, which for the purpose of this study was changed to "office computer with Internet access." For example, number 6 states "I have a very limited knowledge about the innovation." This statement was changed to read "I have a very limited knowledge about my office computer with Internet access."

Faculty Development Technology Workshops Survey. In order to best determine the needs of the faculty for technology workshops, a faculty development technology workshop survey was sent to the faculty members. The survey asks them to indicate if they are interested in workshops on software applications for word processing, presentations, statistical analysis, a mail reader, and Internet explorations. A blank line allows for them to indicate if there are any other workshops they are interested in attending.

Additionally, the survey asks what days of the week are convenient for them and whether they prefer morning, afternoon, or evening sessions. The survey also asks for volunteers to teach or help teach the workshops.

Procedure

In December copies of the Stages of Concern Questionnaire and the Faculty Development Technology Workshop Survey were distributed to faculty members. They were requested to anonymously complete the questionnaire and the survey, then return it to the researchers. The instructions on the questionnaire ask them to read each question and answer it in terms of their present concerns. Data from the questionnaire and the survey will be used to determine staff development needs, specifically what staff development is needed based on the faculty's levels of concern. During the remainder of the academic year, technology workshops will be offered to the faculty as well as one-on-one support. At the end of April, both the questionnaire and the survey will be redistributed to the faculty. This data will be used to determine growth in faculty stages of concern. Further, data from the questionnaire and the survey will be used to assist in planning the faculty development workshops to be offered during the following year and to help determine other ways to assist the faculty as they discover new ways to use the technology. Faculty will be at differing levels of concern and will need different types of support as they learn to use and teach with the available technology. Faculty development workshops will be more effective if they are tailored to address the immediate faculty concerns.

Data Analysis

Responses to the SoCQ will be tallied on the SoC Quick Scoring Device as both raw scores and percentiles. Raw scale scores will be tabulated for each of the 7 subscales and converted to percentiles. In order to determine the range of peak scores within the faculty, the number of individuals scoring high on each stage will be tallied. Then, individual data will be aggregated to deduce the mean scores for each stage. This will provide information as to the dominant high and low stages of concern of the faculty that will be interpreted based on the definitions of the Stages of Concern. To provide additional insight into the faculty's stages of concern, the second highest stage scores for the group will be analyzed to determine if the second highest Stage of Concern is adjacent to the peak Stage. This pattern of highest and second highest stages of concern being adjacent is related to the developmental nature of concerns often associated with innovations.

Discussion

Many factors impinge on faculty's movement through the stages of concern. This progression requires more than knowledge of the innovation, time to use the innovation, and successful experiences with the innovation. Faculty movement through the stages is highly personal and impacted by faculty capabilities and other demands on their time (Wilkinson, 1997). Providing hands-on workshops and one-on-one assistance will foster movement through the stages for most faculty. However, for some faculty their " history, dynamics, and capabilities may make resolution of certain concerns nearly impossible" (Hall, George, & Rutherford, 1977, p. 15). Hence, every faculty member is not expected to progress through all of the stages. Support must be provided to them at their stage of development, as they learn to use their office computers with Internet access and the other technology available to support their teaching.

Determining the faculty stages of concern and providing support as they learn to use the new technology is the first step. The next step will be having them integrate technology into their classrooms. Realizing, as have others (Roberts & Ferris, 1994), that the acquisition of computers and using them for personal benefit is only the beginning, an ongoing area of focus will be on working with faculty to integrate technology into their classroom teaching. Teachers' self-perceptions of their expertise are highly correlated with the implementation of technology into their teaching (Harvey, Kell, & Drexler, 1990). If faculty are to integrate technology into their classes, they must feel comfortable using the technology. According to Roberts and Ferris (1994) this takes approximately 1,000 hours of training. Training, support, time, and leadership are necessary for the successful integration of technology into classrooms. Technology integration into classes will require faculty who feel comfortable using the technology, as well as changes in their teaching methods, and changes in their roles as teachers.

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Faculty Development Workshop: Critical Reflection in a Web-Based Environment

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The ability to think reflectively about teaching has been suggested by many as a key aspect in developing effective teaching practices (Schön 1991; Stevens, 1988; Stevens, 1989). Faculty development efforts have recently been directed towards fostering reflective thinking. The goal is to assist teachers in uncovering personal philosophies of learning and the impact of these philosophies on their practices. The assumption during this effort is that changes in teaching practices occur most effectively when people know why they do the things they do. A faculty development workshop (originally presented in a traditional setting) was created to foster reflective thought about teaching philosophies and practice. To make the workshop accessible to a larger population and to integrate the latest technology, a decision was make to "put the class on the Web." The process of creating, redesigning, and piloting the Web-based workshop as well as results are described.

The major challenge in designing a Web-based version for this workshop was the creation of an environment that facilitates the same type of reflective thought that was generated by small group discussions. A reexamination of theories that define effective teaching and learning was our first step in addressing this challenge. Typically the emphasis on quickly generating a Web-based product takes precedence over careful consideration of what is being done and why. Often what occurs is the presentation of lecture notes in a Web-based environment (Hirumi & Bermúdez, 1996) where little has changed except the method of delivery. However, changing the delivery method should redefine the content and/or presentation. According to Morrison, Ross, and O'Dell (1991) technology that facilitates learning can also limit the experience. It is in the process of integrating technology into teaching practices that the boundaries between facilitation and limitation are clarified.

The purpose of this paper is to describe the process our team used over a six-month period creating, redesigning, and piloting the Web-based workshop as well as the results from our efforts. The motivation for the workshop, the value of the workshop, the way theories informed design decisions, the prototype implementation and evaluation process, and the results/lessons learned are presented in the following sections.

Motivation for Workshop Creation

Moving this workshop from a traditional classroom-like setting to a Web-based environment was motivated by the desire to make it accessible to a larger population and to integrate the latest technology. The very nature of Web-based instruction implies benefits in terms of control over accessibility, convenience, self-containment, and cost effectiveness (Kahn, 1997). However integrating technology in the learning process is not a simple procedure. If we, as a group of instructional designers, were challenged with the transition to a Web-based environment, then teachers (the intended workshop participants) must be equally challenged. By creating this workshop which utilizes Web-based technology, we are providing teachers a "hand-on" experience of learning in this new environment.

Participation in this workshop supports teachers in creating a vision of using Web-based instruction in their own practices in two different ways. First, it supports teachers' critical reflection of their practices through structured reflective activities. Critical reflection is a skill that helps a teacher to develop professionally, make informed

choices, and develop a rationale for practice (Brookfield, 1990). It is a subset of the much larger process of reflection. It specifically encourages a teacher to examine dynamics that sustain all educational practices and to question assumptions and classroom practices (Brookfield, 1990). Each of the workshop activities provided a framework for teachers' critical reflection on their own teaching philosophies as well as their practices.

Secondly, it provides hands on experience with technology. Progressing through the activities, teachers experience and can appreciate the elements of navigation, design layout, on-screen text presentation, and facilitated communication with others. According to Willis (1994), providing a "hands on experience" with technology is an effective strategy for faculty development using distance education technology. Participants in the workshop were provided an opportunity to experience the logistics of learning in a Web-based environment and experienced an effective design that encourages critical reflection.

Potential Value of the Faculty Development Workshop

Promoting discourse on the rationale and methodologies of instruction may be one of the most valuable applications of this workshop. The noticeable absence of conversations about teaching among professors may be partly the result of either a lack of experience or of pedagogical knowledge. Pedagogical knowledge, knowing appropriate teaching strategies, distinguishes reflective from non-reflective teachers. Copeland, Birmingham, DeMeulle, D'Emidio-Caston, and Natal (1994) summarized meaning making in classrooms for novice, apprentice, and master teachers. Apprentice and master teachers appeared to focus more on the quality of students thinking, engaging students in the process of learning, and improving their disposition toward learning than did the less experienced group.

Introspection and reflection may promote improvement in teaching but may not happen intuitively for all adult learners. In an exploration of the myths of adult learning theory, Brookfield (1992) identifies the misconception that all adult learners are self-directed. Some teachers may wish to be reflective about their practice and philosophy but hesitant about whether or not they can effectively reflect in isolation. The unique environment of facilitated discovery in a Web-based environment provides an opportunity to reflect regularly and conveniently about their philosophy and teaching practices. This reflection could result in clarification and alignment of teaching perspectives and practices (Brooks & Brooks, 1993).

Theory Informs Design Decisions

One of the primary questions we wrestled with as a group of designers was whether or not the Web-based environment is an appropriate medium for facilitating critical reflection. Further if this environment were appropriate, then how would it be designed? What would it look like? These questions stimulated our subsequent design decisions.

Extending the workshop to a Web-based environment necessarily altered the roles of the facilitator and the participants. However, the basic assumptions and learning objectives from the original workshop remained constant. In a traditional workshop setting, the facilitator designs the specific activities, manages their order, determines the amount of time spent on each activity, and relies on visual cues to motivate and engage participants. The facilitator is in control of the learning environment. The transition to a Web-based environment shifts the control of the learning activity from the facilitator to the participant.

This shift in control of learning forced us as workshop designers to reexamine theories of adult learning, instructional design, and motivation. Creating learner control in a Web-based environment requires detailed attention to the design, layout, and presentation of the workshop.

Several different strategies were used to shift the control of learning from the facilitator to the learner. One strategy was to use a table of contents to organize the activities and to provide a vehicle for navigation throughout the workshop. Using this tool, participants had the freedom to choose from five distinct activities. Participants selected which ones to complete, the order, and the time spent on each. Every activity included statements regarding the potential relevancy of the activity and invited participants to think about their teaching philosophy and their classroom interactions. As a second strategy, the workshop was designed as a closed environment. Unlike other Web-based environments which contain multiple hot-links to other outside sites where a user can easily "get lost", this workshop is self-contained. Teachers can work through all the reflective activities in an arbitrary manner, but are provided no links to remote sites. This design feature reduces cognitive load on teachers and supports the less experienced user.

We also examined ways to motivate participation in the activities. This was realized through the use of pictures, readings, quotes, animation, and poetry (Williams & Tollett, 1998).

In addition to the structural changes made to the workshop, specific activities needed to be redesigned to fit the Web-environment. For example, in the original workshop participants were asked to draw a timeline of the highs and lows of their teaching experiences on a large piece of paper. This timeline provided a framework for examining their teaching history and led to an examination of potential new directions. Obviously this type of exercise presented a challenge in the Web-based environment. The "Map" activity was transformed into a guided journaling activity called, "My Journey: Finding Direction by Reflecting on the Past."

Adult learning theory suggests the social construction of knowledge is an important element of any learning experience. Due to the asynchronous nature of the Web environment, social interaction must be carefully constructed. In the pilot of the workshop, we created the role of a "facilitator" to address this concern. As participants completed each activity, their reflections were sent to the "facilitator" with the expectation of receiving a meaningful response in a timely manner. According to Wlodkowski and Ginsberg (1995), and Pintrich and Schunk (1996) facilitators may promote motivation by providing positive, accurate, personal, and timely feedback. This facilitator component of the design emerged as problematic in addressing the need for social interaction during prototype testing. This aspect of the workshop needs to be redesigned.

Prototype Implementation and Evaluation

The development of the workshop and its implementation was a dynamic, ongoing collaboration that we characterized as iterative enhancement. As we explored various theories of adult learning, instructional design, and motivation, we were challenged to define ways these theories would be realized in a Web-based environment. After launching and tinkering with the workshop, we reexamined whether or not the translation met expectations. Extensive changes were entertained. Then it was back to the drawing board to refine the implementation. After multiple iterations of this process, we agreed that formative feedback was essential before proceeding further in our design, redesign process.

We invited two graduate instructional design classes to complete the workshop during their class time. 35 students independently accessed the Web-site to test our prototype.

The pilot population consisted of teachers, library media specialists, instructional designers and ranged in age from 22 to 50 (mean = 37). Approximately two thirds of the population were women. An interesting side note: while 71.5% of the participants labeled their level of computer expertise as competent, highly skilled, or expert, over half of the participants (51.4%) reported this as their first on-line workshop experience.

This testing provided feedback on the content of the workshop as well as its design. Five different methods for data collection were used: students' responses to workshop activities, observations of students and faculty, individual interviews, focus groups, and the workshop survey. These five forms of data collection provided multiple views of workshop activities in promoting critical reflection as well as specific feedback on the design layout and presentation. The data collected contributed to a framework for reflection on the highlights and pitfalls of the workshop thus allowing for a thoughtful redesign.

Redesign and Lessons Learned

Two major successes of the workshop were brought to light through this formative evaluation process. It was clear through comments, observation, and written responses that the Web-based environment is a viable medium for delivery of the faculty development workshops. Our findings revealed that the participants were able to overcome technological challenges and successfully work through reflective activities. This validated our assumption that the Web-based environment can be used to facilitate critical reflection. Additionally, we discovered that the workshop is applicable to a larger population than originally suspected. The target population in development of this workshop was college teachers; however, the prototype evaluations and reflections revealed that other groups of professionals, such as librarians, K-12 teachers, and instructional technologists, also found the experience valuable and thought provoking.

Students said that they particularly liked the poems and graphics of the workshop. One student wrote, "the poems selected were appropriate and fit with pictures." Another student said, "readings-poems fit exercises." Students also felt that the reflection exercises associated with each activity did serve their intended purpose (i.e., to stimulate thought and critical reflection). Comments like, "open-ended questions did stimulate reflection" and "the program forced you to reflect in a way that you otherwise seldom take time to do," led us to conclude that the workshop had succeeded in promoting reflection among its users. Lastly, the data revealed that students were pleased that they were able to navigate freely through the workshop. Students made the following comments: "I liked the open-ended questions - no correct answer" and " I liked being able to move from one activity to another."

One major concern arose from our study of the data. The pedagogical inventory activity appeared to be the weakest of all five activities. Students felt the response choices in the inventory did not relate to the questions asked. Students also questioned the rationale for selecting only one teaching practice for redesign. "The inventory only asks for one change to make. How could someone only have one if they were really reflective?" These concerns strongly implied a redesign of this activity is necessary.

Another important piece of information revealed from the data focuses on the design of Web-based instruction. There were aspects of the workshop design that were positive and others that were irritants. For example, students liked the background design used on all the Web page activities and felt it was not distracting. One student said the background let them know that they were still in the workshop and hadn't "gotten lost on the Web." However, students did not like the use of different fonts of varying sizes, the size of the answer boxes, nor the verbosity of the text. The feedback from the pilot emphasizes the importance of utilizing

consistent design principles throughout a Web-based environment.

Conclusion

The faculty development workshop was created through multiple iterations of conceptualizing workshop activities, implementing design decisions, and examining theories of learning, motivation, and instructional design. The result of this process was a Web-based instructional workshop piloted with a group of 35 participants. Our findings suggest the Web-based environment is a powerful medium for workshop delivery and for the promotion of reflective thinking. An equally significant revelation is the importance of a good instructional design on the Web. Nonetheless, consideration of technological limitations and their implications for student learning and motivation are among a number of important issues to focus on in future research. Although the workshop was originally designed for college faculty development, the pilot revealed a broader application audience to include other groups of professionals such as K-12 teachers, library media specialists, and instructional designers. The lessons learned from our Web-based design experience will be foremost in our minds when we redesign the workshop prototype into a functional online workshop.

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Using Technology in Instruction: Supporting Teacher Education Faculty Development

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The Information Age has arrived at a time when a revolution is taking place in education, with many groups seeking to address identified problems within U.S. schools (Boyer, 1985; Carnegie Task Force, 1986; Holmes Group, 1986; National Commission on Excellence in Education, 1983; NCATE, 1997). Studies reporting that our system of public education is failing to meet the future needs of our country or our students, and pointing to the desperate need for revitalization are plentiful. Three decades of research in the cognitive sciences now serves to support change in teaching practices. School districts recognize the need for teachers to help improve classroom practice by moving away from teacher-centered, single discipline, product-oriented environments in favor of student-centered, multi-disciplinary, process-oriented centers for learning that integrate computer technology in educational settings (NCATE, 1997; OTA, 1995; West Seneca, 1996; Riel, 1989). In order for entry-level teachers to integrate technology as a meaningful part of new instructional practices, teacher education faculty need to both demonstrate and support technology as an integral part of coursework.

Educational use of and emphasis on Information Age technologies has resulted in an increase in both the number of computers and the quantity of computer-related equipment in public schools despite ever-decreasing fiscal resources. According to a recent report issued by the US Office of Technology Assessment (1995), however, teachers are neither regularly using nor integrating computers for instruction on a regular basis. One factor believed to contribute to this problem is that technology-using teachers need to be trained by technology-using faculty in teacher preparation programs. Both new and veteran educators feel inadequately prepared to use computer-based technologies to deliver and support classroom instruction (Hirschbuhl & Faseyitan, 1994; Sheffield, 1996).

Whether in public elementary, middle, and high schools or in institutions of higher education, breaking away from traditional instructional approaches can mean taking risks and plunging into unknown territories. Faculties in college and university teacher education programs, as well as teachers currently practicing in public schools, need support and encouragement in their efforts to transform instructional practices through professional development. Support such as faculty professional development opportunity related specifically to use of technology in teacher education often lacks organizational support, however, and may not be available (Hirschbuhl & Faseyitan, 1994).

The US Congress, Office of Technology Assessment report (1995) devoted two chapters to the importance of professional learning. Entire issues of publications such as the Journal of the Association of Teacher Educators, Action in Teacher Education, and the Journal of Teacher Education, this last published by the American Association of Colleges of Teacher Education, have been devoted specifically to technology and teacher education. In addition, a rapidly increasing number of electronic resources are available to those teachers and teacher educators who recognize the critical importance of sharing ideas about technology, subject matter content, teaching practices, student achievement, assessment issues, as well as both positive and negative aspects of using technology in classroom settings.

In recognition of the need to improve preparation of future teachers and following a series of discussions, the faculty of one mid-sized college's department of elementary education devised a plan to integrate technology into their preservice teacher education courses. The approach taken in developing this action plan was based on beliefs similar to those presented by Fox, Thompson, and Chan (1996). In general, faculty members on the ad hoc technology implementation committee agreed that all prospective teachers need to be confident in their ability to use computers, that cooperative learning projects and activities support knowledge construction, and that integrated curriculum promotes meaningful learning. The program devised by this committee also reflected a belief that offering a single core course in computer technology for education might imply that computers were an "extra" feature in education rather than an integral part. A further consideration of the committee was that a core course would be difficult, if not impos-

sible, to staff and include in students' already full schedule of professional sequence courses.

In a move to empower faculty and to promote the integration of technology into instruction and professional activities, faculty members agreed to participate in a three week preliminary group experience. Consideration of faculty input, review of current literature, and dialog with teacher educators already incorporating technology into their instruction revealed three conditions that have a strong impact on the quality and nature of teacher education faculty use of technology: training, access, and context. The program devised by the committee, therefore, included a training program designed to meet the needs of faculty members with varying levels of expertise. Issues dealing with access to computer equipment and related materials were given increased priority. Following the training program, both full and part time faculty who had participated were given access to office equipment (with some assurances of upgrading in the near future). Finally, issues relating to context included a commitment to group support, shared experiences and materials, and more integration of educational technology in classroom instruction and assignments. These elements formed the foundation for preliminary program development and they are expected to be critical in the ongoing integration of technology in our teacher education program.

Inservice Technology Training Program

When the Faculty Computer Use Project began, those involved had varying levels of expertise with computer application software. It was determined that the following three applications would be featured in the preliminary inservice instruction: word processing, presentation software, and computer-mediated telecommunications including Internet access. This selection was based on expressed needs of participants as well as on the belief that these applications might support computer self-efficacy, utility beliefs, and general computer aptitude (Hirschbuhl & Faseyitan, 1994). It was also believed that these applications might best support the use of computer-related skills in the context of instructing undergraduate elementary education methods classes, an essential part of integrating technology into an existing program.

At the outset of the instruction, time needed to be spent explaining some of the basics regarding a Windows environment and ways in which this was similar to and different from a Macintosh environment. Icons and other supportive features of this technology needed some explanation as this otherwise served as an impediment to work planned for this three week session. Group members each were assigned to individual computers, but were seated in pairs such that one member had some knowledge of computers and would, therefore, be in a position to help their partner with these introductory concepts.

According to *Teachers and Technology: Making the Connection* (OTA, 1995), many teacher education faculty neither model the use of technology as a means by which to meet objectives in the courses they teach, nor do they teach ways in which information technologies support instruction. The first application presented in the Faculty Computer Use Project was word processing with a specific focus on developing materials that would directly support faculty work in preparing for and teaching undergraduate methods courses and would also reduce time spent attending to committee obligations such as producing reports and minutes of meetings. Faculty reported that this training had immediate application to their work and might help them connect word processing skills to their students' work and to work that these students might be expected to complete in elementary classrooms. Those involved in this project quickly gained some facility with incorporating graphics into their materials design and found this to be a most rewarding aspect of word processing.

The second set of applications presented included both the college e-mail system and access to the Internet. Faculty eagerly engaged in sending and receiving e-mail almost immediately. This prepared them for the somewhat more complex processes involved in using the Internet. All participants, including the authors, were very excited about the practical uses of technology to promote lifelong learning environments for themselves, for prospective teachers, and for elementary students. Assignments were tailored to individual faculty needs. This was done so that faculty might more easily see technology as a learning tool and, therefore, as a natural inclusion in their coursework and class assignments. Lists of locations of particular importance to various content areas were quickly compiled, and while there was more than a little regret that not all offices were equipped for e-mail and the Internet, faculty nevertheless moved forward in their explorations and attendant alteration of course goals to reflect their newly found skills and awarenesses.

The final application introduced as part of the Faculty Computer Use Project was a presentation package that is available on either PC or Mac platform. Faculty were encouraged to modify an existing presentation, discuss effective slide or overhead presentations, prepare their own materials for class, and consider developing a department resource list of available presentations. This last application proved, in many ways, to be the highlight of the project as faculty used all of their other skills in using technology to develop course materials and to share both materials and ideas with their colleagues.

Contextual Issues

The situation faced by faculty members on campus mirrored, to a large extent, the school settings in which prospective teachers worked. While there was some selection of facilities available on campus, the Faculty

Computer Use Project members had to travel to various locations in order to access appropriate resources. In general, the faculty agreed that there were more opportunities to use technology within a single building in elementary settings than we had on campus. Some discussion was entertained regarding the degree to which elementary teachers were incorporating technology into instruction and the ways that school districts were promoting student development with or without attendant staff development. Project members agreed to become more aware of staff development opportunities available in the districts where their prospective teachers were placed for field experience.

A further contextual issue that became important in the success of this project was related to the support that faculty found and nurtured through their shared experiences. The following excerpts are taken from messages transmitted during this project:

> "I don't want to miss class. Could some of you write to me please and let me know what you did?"
>
> "... if you will put any handouts in my mailbox I'll catch up at home or in the lab after hours."
>
> "My PowerPoint is 3.0. I need to get 4.0. My menu doesn't have the neat option you showed me yesterday. How do I go about getting the new version?"
>
> "I wanted to pass on some information that may be of interest to you. Teachers.Net, the teacher's Internet resource that brought you the Homepage Maker (http://teachers.net/sampler/) and the Reference Desk (http://teachers.net/library/) is pleased to announce the addition of a new resource to the on-line teachers tool kit."
>
> "Cut and paste is a challenge. Specifically, I need to know how to put pictures from Netscape into my Word Processing Documents. Any ideas? See, I have a question everyday. I can't wait to go home and get on PowerPoint and see if I have the effects options."
>
> "I recommend selecting the picture on Netscape by using your right mouse button, saving the picture to your disk (or to your hard drive), and then using Insert command word and choosing Picture. Personally, I have every confidence that you will get past this little hurdle with NO PROBLEM. However, if you have any difficulty, send me e-mail and we will work it out."
>
> "We've gotten through half the workshop with no casualties. I find that I am doing tremendously well in my dreams. Yes, I not only am working on the computer during the day but also during the night."
>
> "It's just great to be surrounded by such talent. I've noticed everyone has become an authority on something...Rosemary you know how to paint, Leslie you're terrific at sending messages, flowers and word association, Joan demonstrates strong ability in SC, GE and GM skills. Kathy's great at taking notes and sharing her knowledge and Marilyn—oh Marilyn, you're the best at giving us laughter!"

This sense of commaraderie continues to support and encourage use of technology by the faculty. Of the nine participants, all now have a computer and modem in their office and two also have purchased new equipment for home use. Thus, while we continue to work toward gaining easy access to technology on campus, faculty continue to support infusion of technology in their personal and professional contacts and associations.

Summary

Both NCATE (1997) and the Office of Technology Assessment (1985) point to the need for teacher education instruction in technology. In order for student teachers and other preservice educators engaged in field experiences to integrate needed technology skills, they first need to be taught by those who value such experiences and who use these skills in their own professional practice. In the Faculty Computer Use Project, we have learned that when technology is infused and supported through meaningful, contextualized experiences in a college setting, faculty are inclined to incorporate technology into their planning and coursework and express interest in sponsoring their students to do likewise.

It is recommended that appropriate training be given to faculty in order to overcome their fears of using computers for instruction and to increase their technological literacy. While many barriers may be seen to exist in infusing technology into a lifelong learning program, faculty who have successfully completed projects such as presentations and gathering course materials from electronic sources may well experience an increase in confidence and enthusiasm that will only increase over time. The importance of providing opportunity and time for faculty training cannot be overstated if infusion of technology into educational settings is to be accomplished.

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Faculty Development and Instructional Computing

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During this era of accountability, institutions of higher education share the common concern of how to present themselves as effective and efficient places of learning. Public scrutiny of academic programs, research projects, faculty workloads, and overall performance has led colleges and universities to take a closer look at how they are using and developing their resources. The use and development of resources is often a crucial factor when making decisions for financial allocations or applying for external funding (Weber, Engle, & Knaub, 1995). Therefore, institutions of higher education, must create plans of action to effectively use, develop, and expand the resources that they have.

One of the most important resources in a college or university is the faculty. The faculty plays many different roles in the education process. They provide instruction, research, and service. All three areas of activity are vital to institutional and community programs at the local, national, and international levels. Because the faculty is so important to the survival and growth of institutions of higher education and other communities, it is essential that programs of professional development opportunities be made accessible to the faculty. A faculty development plan should include professional activities for individual, instructional, curriculum, and organizational development (Jussawalla, 1990).

There are many factors to consider when planning a program for faculty development. Staff development can be systematic and incidental. Institutions may consider the type of professional development plan that is created such as: (a) the management centered type of plan determines what instructors do over a period of time; (b) the instructor centered type lets the individual plan for personal improvement in an educational environment; and (c) a partnership type of plan that includes input from both the management and individuals (Ediger, 1996).

A three dimensional approach to planning programs may be most effective. The first dimension is based on the amount of experience that the individual faculty members possess. The second dimension describes faculty roles which can include instruction, scholarship, creativity, service, or personal growth. The third dimension deals with the organizational level at which the development opportunities are targeted. Opportunities can be offered to individual faculty members, particular units, the academic profession, and the non-academic community (Menges, 1990).

No matter what type of opportunity, program, or approach is used, each institution should create a plan for faculty development that is successful at meeting their unique needs. Successful faculty development programs provide training that will provoke, stimulate, and guide educators to use and integrate new concepts (Imants and Tillema, 1995). Faculty must be given the opportunity to acquire materials, skills, and ideas that they can use for their own professional growth. These opportunities must be accessible, timely, pragmatic, and easily adaptable in order to be effective.

Most faculty/professional development in higher education revolves around the premise that faculty responsibilities are in three areas, teaching, service, and research. Therefore, faculty and college administrators may need to agree on and consider some of the following as key development areas for faculty:

1. Vitalizing students' interest in learning by using exciting teaching techniques including technological media.
2. Creating assessment techniques with the goal of improving teaching and learning.
3. Using techniques for teaching critical thinking and developing creativity in students.
4. Increasing skills for mentoring and advising students.
5. Forming an educational environment that includes instructional computing techniques such as on-line instruction, where quality of time may be as important as quantity of time spent in instruction.
6. Increasing oneís knowledge of how to use technological tools for instructional purposes.
7. Synthesizing past experiences with students with new instructional strategies.
8. Developing skills in the ethical use of new technologies.

The primary purpose of this paper is to share the experience of conducting a needs assessment survey to help determine and create a faculty development program that would best meet the needs of the Eastern Kentucky University (EKU) community. Eastern Kentucky University is a regional university with approximately 15,000 students.

This institution of higher education honors a tradition of providing excellent undergraduate and graduate teacher education programs. All nine colleges participate in the development and governance of the teacher education programs. Teacher education is a university function which includes all of the faculty, staff, and services. Therefore, it is vital to offer a faculty development program that meets the needs of the entire university community yet still focuses on the trends and issues concerning teacher education, especially in the area of instructional computing.

It was determined that the planning goals for such a program should include systematic and incidental opportunities. Planning was to include experience, faculty, and organizational dimensions. And, the development process would be a partnership plan that considered both management centered and instructor centered types of information. In order to meet these goals, faculty input was essential. To obtain the desired information from the faculty, a needs assessment was conducted. This assessment instrument elicited data from the faculty about their desired types of professional training topics. This paper will provide information about the procedure used to conduct the faculty needs assessment survey, a description of the survey results, and information about how these results were used to create a faculty development opportunities program for the academic year of 1997/98.

Procedure

The topics and themes of the previous yearís professional development workshops, presentations, and seminars were listed and reviewed. The list of these topics was acquired through studying the scheduled events of the 1996/97 academic year as well as the suggested topics that were generated at a faculty breakfast conducted in April, 1996. Faculty were invited to attend a breakfast meeting were ideas about faculty development were exchanged. These ideas were organized, compiled, and given to the office of the Associate Vice President of Academic Affairs and Research.

The best way to discover what the faculty wants and needs to learn in the area of instructional computing skills is to ask them. Information will be relevant and the faculty can feel ownership in the planning process. In order to provide the opportunity for faculty to become involved in the process of planning a program for faculty development for the academic year of 1997/98, a survey was mailed in the early Spring of 1997. This survey included information and questions to help faculty list the type of topics they wanted scheduled for professional development. Themes that matched the professional development areas used for faculty promotion, tenure, and evaluation were included as a guide to an awareness that a distribution of topics across all areas of faculty development was needed. These themes (instruction, scholarly activity, and service) also reflect the mission of the university. The following information was provided on a survey form entitled Faculty Development Opportunities Needs Assessmentî and distributed to each faculty member.

The Office of the Associate Vice President of Academic Affairs and Research has begun to plan faculty development opportunities for the 1997-98 academic year. Although it may seem to be very early, faculty input at this time is valuable and necessary to designing opportunities that best meet the needs and schedules of the faculty.

Listed below are three professional development themes (instruction, scholarly activity, and service) as well as input lines for several suggestions per theme. Please provide your name, campus address, campus phone number, and a brief description for each of your faculty development ideas. The list on the back of this page contains a compilation of topics that have been previously offered or suggested. You are invited to use this list as a springboard to create your own ideas or to choose a 1996-97 topic that you think should be repeated.

Lines for each theme were provided for the faculty memberís name, campus address, phone, and description. At the end of the needs assessment survey, a call for faculty involvement was included as follows:

> "Are there any workshops or other types of faculty development opportunities that you would like to host or present? Please list the titles or topics in the space provided below."

The faculty were asked to complete the survey form and return it by February 21, 1997. A campus address was given.

Survey Results

The topics for professional development that were listed by the faculty were placed into areas of common concern called themes for the purpose of planning development opportunities. These themes and the number of suggested topics were organized as follows: (a) technology with thirteen suggested topics, (b) instruction with six suggested topics, (c) assessment with five suggested topics, (d) professional activities with five suggested topics, (e) learning styles with four suggested topics, (f) health and wellness with four suggested topics, and (g) service with three suggested topics. Results from the survey suggest that the faculty had an interest in training in the area of instructional computing. The specific topics for this theme for professional development were requested as follows: computer assisted instruction, using the computer, database management, desktop publishing, SPSS for Windows, changing library services, Web workshops, how to create a course for the Internet, Internet seminars, instructorís guide for teaching by television, PowerPoint, teaching on the Kentucky Telelinking Network (KTLN), and Word Perfect 7.0.

A review of the suggested topics as listed by the faculty revealed that some topics were very general in nature such

as computer assisted instruction or using the computer. Some were somewhat specific to particular type of purpose such as database management, desktop publishing, changing library services, Internet seminars, etc. While other topics were quite program specific such as SPSS for Windows, Word Perfect 7.0, or PowerPoint.

The Faculty Development Opportunities Plan

Information from the needs assessment survey was analyzed and a plan for the faculty development program was developed. This plan had to address budgetary and other major concerns such as: (a) time and duration of the training; (b) types of presenters and speakers; (c) location of the services; and (d) types of formats that would best meet the needs of the participants. When providing training in the area of instructional computing, such variables as time, duration, and location are extremely important to consider because equipment and laboratory space must be reserved for such service. Presenters and speakers must have content knowledge as well as presentation skills that can assist audiences in understanding technical information. The format must meet the need of the skill requested. Short term workshops or long term courses must be carefully selected to meet the time needed to appropriately cover the topic and for the participant to adequately assimilate the information.

After reviewing resources, suggestions, and concerns, faculty development opportunities were offered to the faculty that were diverse in format, location, and schedule. These opportunities included instructional computing training in the form of: (a) short and long term workshops; (b) live satellite Public Broadcasting Service (PBS) presentations; (c) short courses offered by Special Programs; (d) a two-day Instructional Computing Expo; and (e) full term courses. Although a calendar of events was created and distributed to the faculty for the Fall 1997 term, incidental types of opportunities for faculty development were added as the need was identified.

A variety of institutional resources were needed to fund, locate, and equip the faculty development opportunities. These resources included: (a) faculty scholarships; (b) mini-grants for faculty research; (c) training sessions provided by the Academic Computing and Telecommunications Services (ACTS) staff ; (d) training sessions provided by the Extended Programs staff; (e) training and services provided by the Media Resources staff; (f) services provided from the Library Resources staff; (g) services provided by the staff from Special Programs; (h) services provided by faculty and staff willing to share their expertise; and (i) outside speakers and services. It should be noted that faculty with skills in the area instructional computing were invited to participate in the Instructional Computing Expo. This expo was a two day event that invited the university community and education reform partners from the local area schools, community colleges, technical schools, and business community to attend.

Conclusion

The faculty at Eastern Kentucky University were asked to participate in the planning process of a faculty development program for the 1997/98 academic year. Participation was elicited from the faculty by asking them to provide information about the topics they would like presented. A needs assessment survey was used to obtain this information.

Analysis of the data collected from the completed surveys revealed that the faculty requested development opportunities in seven categories or themes. One of theses themes was technology. Further study of the suggested topics for this theme indicated that some topics were very general in nature, some targeted a specific purpose, and some were very program specific.

When planning faculty development in the area of technology, instructional computing topics as listed by the faculty were used. A variety of formats such as workshops, presentations, training sessions, satellite broadcasts, and a two-day expo were planned. Different locations, schedules, speakers, and materials were used to address the variety of faculty needs, experience, motivation, and depth of understanding. A variety of funding and staff resources were used to provide many different types of activities. The faculty were asked to participate as learners and presenters and the calendar of events remained open to requested, incidental activities.

It is recommended that institutions of higher education make a cooperative effort between faculty, staff, and administration to plan professional development opportunities and that all perspectives be considered during the development process. Part of the planning process should include an invitation to all of the members in the university community to actively participate.

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Instructional Technology Training: Multiple Strategies for Multiple Learning Styles

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Training in instructional technology should be provided in a variety of formats to accommodate different learning styles. At Moorhead State University, several strategies for faculty and staff development are underway. Group instruction, instruction tailored to the needs of individual departments, faculty/student mentorships, and individualized instruction are provided.

Background

Until recently, most faculty and staff at Moorhead State University did not have access to a computer on their desktop. The addition of a Student Computer Fee enabled the university to secure personal computers for faculty and staff as well as additional computer laboratories for students. Now that nearly all faculty and staff have computers on their desktops, there is an ever-increasing demand for training in the use of products and software designed for personal computers rather than the mainframe applications previously used.

In the past, workshops have been offered for training in virus checking, basic Internet activities (e-mail, Web browsers, ftp), and a variety of personal productivity applications. However, there is an increasing need for training that is tailored for individuals and departments. In addition, faculty need to be exposed to the ways in which instructional technologies can be integrated into existing courses.

During fall semester, six hours of load from a faculty position were earmarked for providing training in the use of instructional technologies. I indicated an interest in providing training in instructional technology. In addition to my background in computer science, I have an undergraduate teaching degree and previously taught high school mathematics. I developed a course ìTechnology for Teachersî which has been offered for two years at Moorhead State University. Several years ago, I also developed an ìIntroduction to the Internetî course for the university. In the past several years, I provided a series of training sessions for faculty interested in Internet technologies and another series for administrators at MSU. These activities have now expanded into a defined role for Instructional Technology coordination at our university.

Goals for instructional technology training at MSU include the integration of technology into existing courses, effective use of appropriate technologies for the desired learning outcomes, and provision of training in a variety of formats to address different learning styles.

Integration of Instructional Technology into Existing Courses

An introductory education course was developed several years ago which serves as a model for the integration of instructional technology into an existing course. Dr. Ficek collaborated with a professor from the education department to retrofit the entry level course for preservice teachers. The goal was to utilize the Internet as an information source and as a means to improve communication among students in the class, students working in cooperative groups, and students with their professor. Students were instructed in the use of an Internet browser, e-mail, and a presentation tool. Gradually the course added additional instructional technology tools to assist in the goals for the course. For example the cooperative groups now create a Web-based research project. The entire class has access to each group project, and each individual utilizes the information in these projects for an assigned paper. The members of the class also subscribe to a local listserv (to enable sharing of information/discussion) and a listserv devoted to disabilities.

Effective Use of Appropriate Technologies for the Desired Learning Outcomes

This goal is vitally important ñ the professors are interested in utilizing technology in ways that enhance and augment the course objectives. Most are not interested in adding technology simply because it is available. Many of the group workshops begin with comments about how and where the tool has been used effectively in instruction. Ideas about how to utilize the tool within the context of a specific discipline are typically discussed as well. In other words, the

instruction is not simply on the keystrokes required to perform certain functions. Instead, each function is introduced in the context of how it can be utilized in instruction or for preparation of course materials.

Provision of Training in a Variety of Formats

Training for faculty and staff has proceeded in a variety of formats, including:

1. Group training
2. Cooperative teaching
3. Department-specific training
4. Student/Faculty mentorships

Group Training

Group training in a lab containing 30 personal computers provides an opportunity for hands-on training. The following three series of workshops were developed to address some of the training needs at MSU:

1. Personal Productivity Series
2. Internet Series
3. Instructional Technology Series

The Personal Productivity Series consisted of nine hour-long sessions providing training in Windows 95, virus checking, word processing, PowerPoint presentation software, a scheduler/on-line calendar and Eudora e-mail. The workshops were held on Monday, Wednesday, and Friday from 9-10 AM, and pre-registration was required. Most faculty and staff made use of their tuition waver to take the series as a half-credit course. However, the publicity for the workshops encouraged people to sign up for individual workshops if that fit into their schedules and needs at a cost of five dollars per session.

The Internet Series consisted of nine hour-long sessions providing training in the use of Web browsers (Netscape), Internet search engines, listservs, ftp, e-mail, and downloading/installing software from the Internet. The workshops were held on Monday, Wednesday, and Friday from 9-10 AM, and again, pre-registration was required. For those who needed information on selected topics, registration for individual workshops was allowed at a cost of five dollars per session.

The Instructional Technology Series consisted of nine hour-long sessions providing training in the use of technology in instruction. It was tailored for faculty, primarily. The initial session provided an overview of ways the World Wide Web has been utilized in instruction. The participants visited sites at various ìvirtual universities." Other sessions led the participants through the process of creating an individual Web page using a WYSIWYG environment, using four kinds of hyperlinks within and between documents (links to the Internet, to another local page, anchors within a page, and e-mail links). Next, design and organizational issues were presented to illustrate how to create a Web for an individual course. Microsoft FrontPage was utilized as an example of software which not only facilitates the creation of individual Web pages, but also provides mechanisms to assist in the maintenance of the entire collection of Web pages for a particular course. Conferencing environments were explored, with hands-on exposure to Microsoftís NetMeeting product, which allows for video and audio conferencing, electronic whiteboard, and collaboration on a virtual document.

The group hands-on training situation works well for some individuals, but some people are not able to keep up with the group. For some of the sessions, an assistant was available to provide assistance for those who fell behind. Generally, the approach was one of showing the group the features of the software that were most practical and useful for instructors. No out of class work was required. The participants were given detailed handouts which covered the material so that when they left the workshop, they could practice on their own with the instructions nearby. Handouts were also made available via the Web.

An evaluation was distributed to participants at the end of each of the three series. The majority of respondents indicated they were very satisfied with the training and would recommend it to a colleague.

Cooperative Teaching

A second method used for faculty development was cooperative teaching. This provided a means to incorporate technology into an existing course even before attaining a comfort level with the technology that is usually necessary to teach that technology.

Several professors who had taken the ìTechnology for Teachersî course last year were contacted to participate in a pilot project which would utilize a Web-based writing project. The professors had received hands-on training in the creation of Web pages using a WYSIWIG environment (Netscape Gold), and their classes typically required a substantial writing project. However, the professors were not yet comfortable enough with the technology to provide instruction and technical support for their students. The idea was to incorporate the use of the Internet as an information source along with traditional library sources. The students would be allowed to incorporate links to Internet resources, images, and color as they saw fit.

A cooperative teaching arrangement was made, where the students were given two hours of instruction on basic Web-page creation at the beginning of the semester. The technology instruction was provided by Dr. Ficek, as part of the six-hour release for coordination of instructional technology. Throughout the semester, students were to gather appropriate materials (both traditional materials and materials from the Internet). The students were allowed to use either a traditional word processor or a Web-page creation tool for the initial draft of the paper. Near the end of the semester, two additional hours were provided in the lab

for incorporating the materials into a Web page. Technical assistance was also made available for the students during the semester by providing the e-mail addresses of several student assistants who could provide help as needed.

Three courses were involved in the pilot Web-based writing project. Two were graduate level education courses, and the third was an undergraduate English course. The graduate studentsí projects were well done, and the participants were generally very satisfied with their final product. The undergraduates were asked to present their projects for the class at the end of the semester. Most were able to locate additional resources on the Internet, and they enjoyed incorporating a photograph of their author in the paper. All participants felt they had extended themselves and had worked very hard to achieve their final product.

Department-Specific Training

Hands-on group settings provide a general background in the use of software applications, but each department has needs particular to their discipline. A pilot program targeted professors in the College of Business for training at the department level. The dean was asked to provide a list of 10-12 professors who would be willing and interested in developing materials for on-line instruction. Several members of the faculty in this college currently use ITV to deliver distance education. The addition of Web-based instructional materials, a listserv to enhance discussion among class members, and e-mail access between the professors and their remotely-located students would enhance the distance delivery.

Eight hours of instruction were provided for ten faculty members from the College of Business. Training primarily focused on the development of on-line course materials. Participants utilized a scanner, participated in a local listserv, and learned about organization and management of a Web site. They were also exposed to newer technologies such as the SmartBoard to enhance their distance delivery. The FrontPage Web development software was utilized to create the instructional Web materials and provide an overview of the linkage of the various documents.

Student / Faculty Mentorships

Group instruction is not effective for every faculty member. Some learning styles prohibit participation in group settings. For these people, an individualized environment with readily available technical support is optimal.

Six students were trained in the use of various software and hardware tools. They will each be assigned to two faculty during the spring semester. Funding for the students was provided by a regional grant pertaining to technology. Training was provided by Dr. Ficek during fall semester as part of the six hour instructional technology assignment.

Faculty were expected to provide an idea for a specific project which could be completed in one semester. The student assistants will work with their assigned faculty member for 2-3 hours per week for 15 weeks. Examples of projects which were selected include:

1. Web site for library instruction
2. on-line advising site
3. Web site for internship information
4. on-line instruction for the College of Business MBA degree

The students are expected to work with each individual faculty member to assist them in the use of the software and hardware needed to support the goals of the project and to provide technical assistance and support throughout the semester. The students will be available via e-mail as well for their faculty partner.

Future Directions

While training in instructional technology is vital, on-going technical support must be provided to assist faculty and staff in their efforts to utilize their newly acquired skills. In the future, we plan to train students to provide technical assistance for faculty and other students. Funding will be secured through internal and external grants. The need for technical support will continue to grow, and all training efforts must address the need for support after the training is ìcomplete." A core student technology team has already been formed. Now, it needs to be expanded to serve the needs of more faculty and staff.

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Multiple means of support: The role of the Office of Educational Technology in faculty development

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Technology development in colleges of education has become a high national priority. The reality is that "technology is not central to the teacher education preparation experience in most colleges of education." (Office of Technology Assessment); according to a May 1996 survey of schools of education, only 45% of the faculty regularly used computers, TV's and VCR's as interactive instructional tools during class period. 58% do not have any classrooms wired for the Internet, and 19% have no web site, (Zehr). As a result, many are calling for an acceleration of the integration of technology into the delivery and content of courses as a key to preparation of future teachers. In a recent report, the President's Commission of Advisors on Science and Technology have indicated that "colleges of education should be encouraged to find ways to reward faculty members who include new technologies in the methods of content of their courses (President's Commission). Another influential group, the National Association of Secondary School Principals, has also called for reform. "Preparation to work with technology ought to be basic to teacher education. Teachers should learn to use technology as an ally in helping students make better use of inquiry-driven knowledge construction strategies. Colleges and universities that prepare and certify teachers must accept responsibility for ensuring that those who embark on careers in the classroom reach this level," (NASSP).

To further these goals, the College of Education at the University of Illinois Urbana-Champaign established a new Office of Educational Technology in the fall of 1996, which is supporting faculty with the integration of technology using multiple means. The means of support include co-teaching of technology strands in courses, individualized one-on-one faculty consulting, workshops, and technical troubleshooting and repair. The staff of the OET recognize the need for this broad range of support to facilitate successful integration of technology throughout the various academic programs in the College, and to provide continued support for technology development for faculty and staff.

Technology strands through course work

Within the College of Education, OET staff and College faculty have piloted a stranding approach to technology integration into course work. Rather than presenting technology in semester-long courses in isolation, we have integrated technology into a number of sections of pre-service teacher education courses. The most significant use of this stranding model is in the Year Long Program (YLP), which is an option for elementary education student teachers during their senior year. In the YLP, students concurrently teach in cooperating classrooms while they complete their methods courses. The course work allows the students to reflect upon their practice while they gain more time in the classroom compared to the regular semester-long teaching practicum. Since technological literacy is viewed as an integral part of what it means to be a teacher, course time is provided for training in the use of technology, with the requirement that students test and incorporate technology into their student teaching experience.

The role of OET in this process has been to (1) provide on-going support to the primary YLP course instructors, (2) provide laptop computers for the YLP students, (3) conduct workshops designed with YLP instructors, and (4) co-teach sessions that deal with teaching techniques, integration, and

critical issues of technology. This co-teaching of course sessions goes beyond what is often expected of a college technology support office. We recognize that most faculty are often learning about technology with their students. With co-teaching, we are helping faculty become better "models" of technology users for their students. Co-teaching helps the OET staff stay current with the more important issues of teaching and learning. In that way, we become a more valuable resource for faculty.

The YLP has served as a pilot for redesign of the entire student teaching program. A central construct of the redesigned program is the use of reflection on practice in learning to teach. Technology should be one of the elements of teaching upon which the student reflect. With the redesign, the notion of stranding takes on heightened meaning in that all of the courses are connected along multiple strands which include technology. Our goals of technology integration are based upon ISTE technology competencies. We are currently devising a methods to manage this stranding of technology, which already include the use of web-based support environments for evaluation, technical support, and courseware development. We are also pursuing new techniques of synchronous and asynchronous support for co-teaching, which include video conferencing with cooperating schools, digital interactive video of student and faculty teaching, and increased development of more interactive course web pages.

Individualized Consulting

The success of the first year of operation of the Office of Educational Technology was due in part to its in-house workshop efforts aimed at faculty training. Upon reviewing the role the workshops played in faculty development, however, it was clear that the OET workshops were meeting the general needs of the faculty, but the individual needs of many faculty members were not being met. As a result, a model for consulting within the Office of Educational Technology (OET) was designed.

We assessed the technology needs of the faculty both in terms of hardware acquisition and software application training. This was based on feedback given on the workshop evaluation forms and on requests sent to the OET office staff for help in specific areas. The needs of the faculty fell into two categories. Some faculty needed training on specific hardware or software technologies which they believed could be integrated into their curriculum . Others did not have a technology plan and thus wanted help in determining their technological needs and how those needs could be addressed.

At the beginning of this year, the part-time OET graduate students identified their individual areas of specialization and established the office hours which they would devote to consulting. Each graduate assistant was required to devote 80 percent of his or her assistantship to office hours. Most consulting is done by appointment after a brief meeting with the faculty member to determine how much time to set aside for a future meeting.

Faculty hav been apprised of the consulting hours in three ways: 1) the consultants' hours and areas of specialization are listed on the OET Web pages; 2) within workshops, announcements are made regarding consulting hours; and 3) announcements are made via email. The greatest response for consultation with the graduate students has been via word of mouth during the workshops.

Finally, we have been logging the hours that the graduate students spend consulting. The goal of the tracking is to determine which departments are using the consultants' hours, what topics are being covered, and determining if there are topics which may be better addressed by a workshop that would be geared to departmental or unit needs. This fall, the majority of the consultants' hours have been spent teaching faculty how to use Windows applications and Web authoring software, discussing hardware and network protocols, and helping faculty learn to use multimedia technologies like digital images and digital video.

Workshops

Hands-on workshops are held regularly in the Instructional Computing Lab on a variety of topics for faculty and staff. Topics have been generated by faculty surveys, informal requests, and at the suggestion of OET and ICL staff. Workshops are taught by graduate students, faculty and staff. We try to keep workshops small, hands-on, and when possible, we attempt to have one or two helpers circulate around the room for assistance to participants in addition to the main presenter.

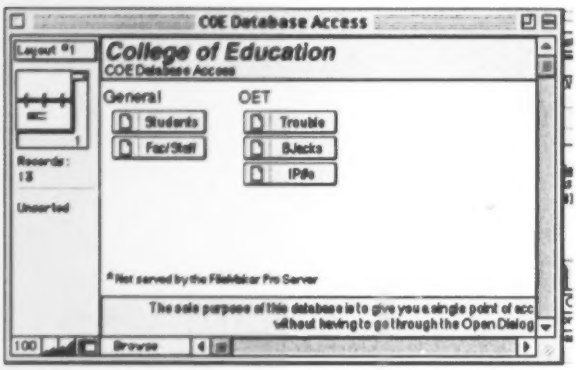
This year we have tried to better organize and standardize workshop procedures. One graduate student helps to coordinate workshops, and he has prepared a workshop packet for presenters. This includes an information sheet detailing the materials to be covered in the workshop, a request for copies of handouts, suggestions for presenters, a sign in sheet for the workshop, and an evaluation sheet for participants to complete.

Workshops are announced at the beginning of the semester both electronically (by an email reflector and on the web site) and by print brochures distributed in mailboxes. Participants can sign up for workshops (which are limited in attendance to the number of computers in the ICL classroom, approximately 15) by phone, by email, or by coming to the office and signing up. The secretary handles records of sign-ups and collects copies of handouts, materials, sign in sheets, et al. and archives this information in a file as well as enters it in a data base.

The actual content of a few of the workshops is posted on the OET website electronically. For example, one workshop on creating slide presentation using PowerPoint was conducted using PowerPoint; that presentation was saved as html and posted on the OET web site.

The Instructional Computing Lab is equipped with PowerMacs (most of which have a PC card) and Pentium machines. The room has a new ceiling- mounted projection system which has been very helpful for instruction. We have found that with both Mac and Windows users in the College of Education, it is better to offer training separately on each platform. We have tried, for example, to conduct a workshop in PowerPoint simultaneously on the PC and Mac platform but have found it too confusing for participants.

Many workshops are on short topics, offered for a two hour time period (such as Using Internet Search Engines). More complex topics are often spread out to a series of three consecutive workshops, each a week apart (such as Creating Your Own Website).



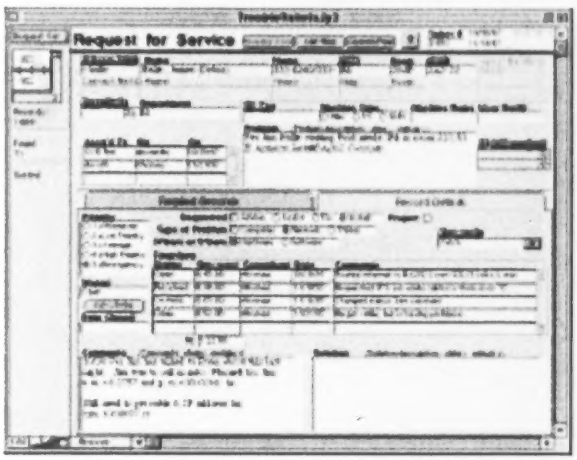
A sampling of workshop topics for this year includes the following: Internet Search Tools, Introduction to Windows 95, Creating Slide Presentations Using PowerPoint, Troubleshooting Your Computer, Using the Internet to Access Library Resources, Introduction to HTML Coding, Introduction to Front Page, Introduction to Data Bases Using FileMaker Pro, and others.

Technical Support

Our technical support efforts have been enhanced significantly in the past 18 months. One of the most important changes has been the implementation of a "trouble ticket" system that allows our support staff to better track requests and to work with minimal supervision. Another, more proactive change, is the implementation of a program known as the "Unit Reps" program designed to distribute technical knowledge and skills.

The hub of the so-called "trouble ticket" system is the full-time OET secretary who plays the role of dispatcher. All requests for help come by telephone to her. She uses Meeting Maker to identify who is on duty and when (and can schedule appointments when necessary), FileMaker Pro to record all "trouble ticket" communications (e.g., requests for support) and to search for related information, and Eudora to communicate more urgent messages to involved parties, including pages for emergencies. The trouble shooter on duty carries a pager and a cell phone.

While the secretary is the hub of the system, the FileMaker Pro database is the primary cog. In addition to providing support staff with a dynamic tally of all open tickets (sortable by many criteria), the data base contains information such as how long trouble shooters spent working on a particular ticket, what was done, and other information for reporting purposes. FileMaker's relational features are used extensively to maximize the utility of the system — related tables include hardware inventory, IP addresses, b-jacks, a faculty/staff table, etc.



Trouble shooting staff currently serve faculty and staff in three buildings, approximately 300 computers. The staff includes one full time and one half time network administrator, a team of three part time graduate assistants (who together comprise one f.t.e.) and an additional hourly network support person from campus computing services. They are hoping to add another half time network administrator soon. In its first year of operation, the Office received over 1000 calls for help. The troubleshooters are often overwhelmed. At particular "crunch" times, we have had to supplement this group with additional part time hourly help.

In addition to the trouble ticket operation, a newly established group is meeting to discuss technical problems. The "Unit Reps" group meets twice a month for training and to discuss common computing-related problems. The goal of this program is to raise the level of technical expertise throughout the college by strategically selecting and training a member (representative) of each unit to communicate what they learn with those whom they work on a daily basis. Units include traditional departments (such as Curriculum and Instruction) and other units (such as the Bureau of Educational Research). The Unit Reps tend to be administrative secretaries in each unit, but the meetings are not restricted to this group. Others are welcome to attend. By emphasizing the fact that they are expected to be role models or teachers rather than "troubleshooters," we communicate our desire to have them show others how to

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help themselves, rather than become burdened by demands for technical support.

Conclusion

Now in its second year of operation, and in its first year of permanent funding, the Office of Educational Technology has supported faculty and staff by multiple means, including stranding, consulting, workshops, trouble tickets, and regular unit rep. meetings. As the Office evolves and matures, we will continue to refine these approaches and, most likely, try others. The exponential growth of technology and its inherent needs for technical and developmental support makes centralized, equitable support a desirable option for Colleges of Education.

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Tutor Training in Computer Science: Tutor Opinions and Student Results

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In 1994, the Dean of the Faculty of Computing and Information Technology (FCIT), at Monash University, approached the Dean of Education for assistance in tackling a perceived problem in the teaching of programming.

Two education faculty academics (Macdonald and Mitchell) were assigned to make a preliminary investigation on the quality of teaching and student learning and understanding in the departments of Computer Science and Software Development. The initial investigation was performed by a project team called "Edproj" which was established towards the end of 1995. Edproj consisted of members from the Department of Computer Science, Software Development and Education.

Monitored observations by Edproj showed that some tutorials degenerated into pseudo mini lectures. The initial observations made by group revealed the following:

1. A wide range of teaching skills, some were excellent but these practices were isolated and rare.
2. A majority of tutors had very primitive teaching skills; with the quality of questioning being particularly low. Some tutors spent the majority of class time talking and writing with few students paying attention. Several tutors spent the tutorial dictating code, another spent much of the tutorial talking with his/her back to the class, and another spending the whole lesson explaining answers.
3. Tutors often were not aware of the main ideas put forward in the lectures, and introduced their own interpretations and idiosyncratic methods.
4. There were very low levels of student talk and participation (sometimes only 2-3% of class time) and during some weeks less than half the students were attending classes.

Many tutors and demonstrators also lacked the skills to build student interest, intellectual engagement and motivation which had a number of negative consequences on student learning, such as:

1. Concepts which were not stated as being for assessment were ignored. Tasks intended by lecturers to be gateways to exploration and reflection were seen by students merely as hurdles to be negotiated.
2. Students wanted to get set tasks done, then they stopped. Students were satisfied once they had the solutions written down in their notes.
3. Many students believed that if they could follow the dictated code they learned the ideas behind it.
4. Students remained passive and tried to learn by listening and note taking rather than by doing.

The 1996 Tutor Training Programme

The Edproj research led to the development of a training programme to prepare postgraduate students for their role as teachers. The programme consisted of a teaching intervention that comprised an initial 3-day programme and ongoing fortnightly training/meeting sessions (Mitchell et al, 1996).

The initial training discussed the nature of good learning and set out a framework of good teaching theory and practice. The Programme discussed Edproj's insights into barriers to learning programming, exposed postgraduates to a bank of strategies for promoting better learning, and introduced a set of fundamental teaching principles that stressed the importance of questioning and linking. The fortnightly meetings provided tutors and demonstrators with the time and skill to discuss student learning needs and made it possible for tutors and demonstrators to share teaching ideas and discuss ways of dealing with student learning difficulties (Carbone et al, 1996).

Goals of the 1997 Tutor Training Programme

Budget cuts in 1997, meant that the Department of Computer Science could no longer afford the expertise of the intervening Education faculty experts, and as a result the Tutor Training Programme was delivered by a staff member of Computer Science and adapted accordingly to reflect the findings in 1996.

In 1996, the Tutor Training Programme began with the following objectives:

1. To share teaching techniques.
2. To improve the teaching skills of tutors.

3. To make tutors aware of the main ideas put forward in the lectures, and avoid different interpretations and idiosyncratic methods.
4. To increase the level of student talk and participation.
5. To promote tertiary level study skills within students.

By the end of the year, the project had built momentum to improve the quality of teaching and student learning. Improvements in the quality of teaching were characterised by the high level of energy, interest and enthusiasm demonstrated by the front-line teaching staff. Observations on the quality of teaching and student learning were made via monitoring classroom activities and interviews with tutors and demonstrators in 1996. Data showed vastly improved teaching practices that linked more closely to the lectures and course aims. As a consequence two new teaching innovations were initiated and developed; the Scavenger Hunt and the First Year Advanced Student's Project Scheme (Carbone 1996). Improvements in student learning were monitored by increased student attendance at tutorials and higher levels of student engagement in these classes (Carbone et al, 1996).

The 1997 Tutor Training Programme

In 1997, the Tutor Training Programme in the Department of Computer Science was delivered by a member from FCIT, without the intervention of Education Faculty experts. The Programme drew on the experience gained from Edproj's research in the previous year, which led into insights of barriers to students learning, a bank of strategies for promoting better learning, and a fundamental list of teaching principles. The initial Programme consisted of six sessions (each of 90 minutes duration) and ran over one and a half days.

Below is a brief description of the material covered in each session.

Session 1

The first session outlined the objectives of Edproj; to improve the quality of teaching and student learning and to understand a technical discipline such as Computer Science. Tutors and demonstrators were introduced to the importance of student learning in the tutorial and laboratory environment. They were exposed to an icebreaker activity and the importance it plays in the initial stages of establishing trust between fellow students and the teacher. Following that, postgraduates worked in small groups to compile a list of statements about their role as a demonstrator and tutor, and the students' role as a learner. The list brought out attitudes that were challenged and collectively discussed.

Session 2

Session 2 covered factors that affect learning; such as lack of student motivation, the nature of student/teacher interaction, transition issues and the nature of programming. The tutors/demonstrators were asked to draw from their own experience and identify barriers to their own learning. Findings from the Edproj investigation were also discussed with the focus on ways to overcome barriers to quality learning. Some of the barriers to learning observed by the Edproj group included:

1. Lack of teaching skills (due to absence of training)
2. The nature of programming (very cumulative)
3. Lack of a clear and coherent view of the entire course
4. Big Ideas are obscured from the high task demands of coding
5. Lecturers view course in terms of abstractions - students saw course as getting programs to compile
6. Low levels of student talk
7. Laboratory situations overloaded studentsí short-term memory
8. Lack of consensus within experts in the domain

Session 3

Session 3 examined conditions of learning *(choice, time and abilities)* and the process of learning through *selection, translation and storing.* Two example role plays were given by experienced tutors highlighting different approaches to teaching; one that encouraged active student participation and one that involved passive listening. Postgraduates were exposed to a small set of fundamental teaching principles which lead to a vigorous discussion on the outcomes of a successful lesson. These included:

1. Good learning involves making links between items of knowledge and with the real world.
2. Students construct their understanding based on the knowledge they bring into learning situations.
3. Active engagement not passive reception, characterises quality learning.
4. Student talk is a vital medium for the above to occur.
5. Student talk requires trust between student and teacher and with fellow students.

The principles selected were ones seen relevant to the most urgent needs of tutors and demonstrators as revealed by Edproj, and feasible to implement in the short time available. These concepts were used for subsequent planning and linked to the context in which the tutors operated.The course stressed the importance of reflection on practice as an essential tool for effective teaching and there was particular emphasis on the important role of student talk in different learning situations.

Session 4

Session 4 included an overview of positive tutor/ demonstrator strategies that were generated as part of the training programme in 1996. These are contained in Appendix A. The strategies covered ways to promote better learning and were obtained from a data bank of innovative teaching ideas collated during the previous year. Postgraduates worked in small groups to apply some of the strategies to a range of small programming tasks that involved teaching

concepts such as Strings, Functions, Arrays, Looping, Structures, Sorting, Searching, Files, Input/Output. The session was concluded by tutors and demonstrators participating in the first year student orientation programme.

Session 5

In session 5, the lecturers were invited to meet with the tutors and demonstrators and present their 'Big Ideas' of the course. The session was aimed at helping postgraduates promote the linking of key ideas. After the lecturers had concluded, tutors/demonstrators were issued with information on how to prepare for their lessons, and attempted to organise their first two lessons for the semester.

Session 6

The final session was devoted to preparing the first two laboratory and tutorial sessions. Demonstrators/Tutors registered themselves on their accounts and systematically worked through the exercises in the first two laboratory sheets, planning their ice-breaker and other activities for their lesson. The remainder of the session was devoted to administrative details including: entering students' marks into a database called the Marks Entry SyStem (MESS) database, the method for casual staff to claim the teaching hours via the Payment Entry SyStem (PESS) database, and a review of the teaching evaluation forms available at Monash (known as MonQueST).

Evaluation of the 1997 Training Programme and Evidence of Effectiveness

Ranking the sessions

After the initial training, a survey was distributed to the participants to find out what they thought about the initial training. Participants were asked to rank each session and provide comments. Twenty two surveys were completed. Of these, all the participants found the Programme well organised and presented. Ten found the material useful and twelve found it interesting. All participants believed that the Tutor Training Programme addressed their needs and recommended that it be continued in the following year. Typical comments from participants in relation to the sessions, included:

1. The ice-breaker was a useful activity for people that find it difficult to remember names.
2. Session 1 was very useful to develop trust between the tutor and fellow member.
3. Session 1 helped tutors start to get their mind on the job and handle it professionally.
4. Session 1 helped tutors know that students should be aware of their responsibilities.
5. It was beneficial in that some of the important points which don't come to mind at first (i.e., "making friends") were reinforced.
6. The discussions in session 2 appeared to be to general, it needed to be adapted to a particular situation.
7. The group work in session 3 that converted code to diagrams and used analogies and role plays was a good way to liven up boring stuff.
8. I found the orientation seminar in session 4 useful because it synchronised the information between the tutors and the students.
9. The preparation check list, in session 5 was a good idea.
10. In session 6, PESS was confusing, an online demonstration would have been better.

The training also had the effect of instilling some positive teaching behaviours amongst the new tutors, which included:

1. I will prepare for my lessons from the viewpoint of the student - catering for students of all types.
2. I will aim to use role plays and analogies in my first two lessons.
3. I will aim to learn my students names.
4. I will refer to the list of teaching strategies, and realistically look at my teaching methods and their effectiveness.

Table 1 gives a summary of how participants ranked each of the session. Sessions were ranked from 1 to 5 (i.e., 1 being the most useful and 5 the least). From this data a final overall ranking of each session was obtained. The data shows that session 5 (the lecturers presenting their Big Ideas of the course) was the most useful session, then followed by the introduction, barriers to learning and teaching strategies. The session considered least useful was the session covering the administration details.

Table 1.
Overall Ranking and Rating of Sessions

Session Number	Overall Rank	Rank 1	2	3	4	5
		Rank Distribution				
1 - Introduction	2	5*	7	7	3	0
2 - Barriers to Learning	4	5	3	4	7	3
3 - Teaching strategies	3	5	7	4	3	3
4 - Orientation						
5 - Big Ideas of the course	1	9	4	4	3	2
6 - Getting started - administration	5	2	5	3	2	10

Numbers inside the table represent the number of participants giving that rank

Feedback received from the twenty two co mpleted surveys was very positive. Eighteen participants believed that the Programme did address their needs and nineteen participants recommended that the training be continued in the following year. More general comments about the initial training and the ongoing fortnightly meeting included:

"When I began my Honours year in Computer Science (in 1997) I decided to become a demonstrator. I found the initial training course for demonstrators to be a very informative and energetic introduction to the life of a demonstrator."

"The fortnightly meetings between demonstrators and lecturers were used to gauge how students are progressing and coping with the course, and whether of not any changes need to be made. If changes were needed they were made during the course and not after the course had completed. We could compensate for the problems now rather than taking the approach,We'll get it right next semester."

Impact of the Training Programme on students' marks

To determine the educational impact of the Training Programme on the students' academic performance, the correlation of studentsí test, practical mark and exam marks during 1996 and 1997 was examined. Average marks of students were monitored for the mid-year exam, and at the mid-semester test, to determine if the average studentsí marks increased or decreased. Table 2 contains the average mark and standard deviation of the students in 1996 and 1997 respectively.

Table 2.
Average mark and standard deviation of the students in 1996 and 1997.

	Average percentage mark and (standard deviation)		
Student Year	practical mark	mid year exam	test 1
1996	76.00	56.10	57.75
(328 students)	(4.2)	(15.8)	(6.4)
1997	78.00	58.00	60.4
(375 students)	(7.8)	(32.5)	(7.5)

The average marks for the 1997 practical component, the mid-semester test and exam, was slightly higher than their respective 1996 scores. Although the three assessment instruments are comparable and at the same level in each year, it is not possible from the above results to draw any firm conclusion regarding the contribution of the Tutor Training Programme on the students' academic performances, it is reasonable to conclude that the training did not appear to be detrimental.

Conclusion and Future directions

The overall reaction to the Training Programme by its participants was highly favourable. Both the tutors/ demonstrators and lecturers showed healthy signs of interest and dedication. Participants enjoyed the training and the Programme is working towards fulfilling its objectives of:

1. Sharing teaching techniques,
2. Improving the teaching skills of tutors,
3. Making tutors aware of the main ideas put forward in the lectures, and avoid different interpretations and idiosyncratic methods,
4. Increasing the level of student talk and participation,
5. Promoting tertiary level study skills within students.

Analysis of studentsí academic performance, in particular performance of the tests and mid-year exam results tends to indicate that the Programme does not appear to be detrimental. However, there is scope for some îfine tuningî if it is to operate again in 1998.

Currently, funding for the Training Programme comes from the Department. Only with continued funding can such programmes be introduced, improved and sustained. However, under the current economic climate it is unclear whether any funding can be devoted to address the needs of postgraduates and Honours students who are newly appointed tutors and demonstrators.

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Appendix A Positive tutor/demonstrator strategies generated (semester 1, 1996)

1. Find ways to liven up boring topics
2. Admit to past mistakes
3. Know students by name
4. Ask questions for discussion
5. Pick up and follow student responses
6. Spread questions around
7. Plan some approaches before hand. Prepare several solutions
8. Closure on student questions
9. No answer without some student response first
10. Relevant anecdotes
11. Reward good thinking
12. Use small words and simple concepts
13. Provide information about the course
14. Find out what student does and does not understand
15. Help set mastery goals
16. Pass understanding, not just quantity
17. Localise problem area
18. Have students step through and explain
19. Rephrase questions
20. Praise students for what they have done
21. Question students regarding content of the lecturers, tutorials and labs to encourage linking
22. Admit to mistakes, work through them and praise student
23. Establish an environment where students feel free to dispute tutor/demonstrator or other students

Life on the Margins: Stories of Techguides

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Traditionally in the intersection of technology and education, two distinct cultures have existed side by side. There have been the "techies"—the technologically sophisticated or enthusiastic experts on one hand, and the teachers—elementary through higher education—on the other. The two groups have tended not to see each other as resources and collaborators but rather as opponents, competing for the same available resources. The techies are inclined to favor as much technology as possible, as soon as possible, for all possible uses. The teachers, although committed in general to the importance of students learning technology, are inclined to feel that within their own realm of operation they are doing just fine, thank you, and really don't need another expensive, time-consuming task added to their already heavy loads. The two groups have also quite negative perceptions of each other. While the "techies" perceive the teachers as "resistant to change", the teachers see the techies as nerds who do not really understand teaching and learning. The two groups attend different conferences, read different journals, and participate in different professional communities.

Neither one of these two cultures is sufficient for successful technology integration, which requires both deep understanding of and caring about teaching and learning AND sophisticated knowledge of and skills in modern technologies. What we need is a third culture. Members of this new culture are marginal members of the other two cultures. In other words, they are techies who deeply appreciate the culture of the teachers or teachers who are thoughtful and enthusiastic technology users. Traditionally, this third group has developed as a result of accidental events occurring to individual members. Many technology-using teachers, for example, take on technology because of an unplanned event. Likewise, many technology people who become really interested in teaching and learning do so because a circumstance of their lives necessitates interaction with teachers and students. This paper describes a deliberate effort to bring the two traditionally separated cultures together to engineer a new culture.

To support technology integration at a large teacher preparation institution, a group of nine graduate students were recruited to serve as "Techguides." One of the primary responsibilities of each techguide is to partner with teacher educators to help them integrate technology in their courses for preservice teachers. These Techguides are pioneers in what we call the "third group." We have deliberately recruited students with diverse backgrounds in technology and teaching and have tried to create a physical environment which is conducive to interactions between "techies" and "teachers". In short, we are trying to foster a culture that enables the two groups to interact with each other, challenge each other, and learn from each other in an explicit fashion.

This paper reports on the preliminary result of such an effort by looking at the developmental trajectory of four Techguides over a course of three months, by attending to the ways in which the physical space in which this project is housed provides a middle ground for the two disparate groups to interact in and impact the development of a new culture for teaching and learning with technology. Two of the Techguides are the stereotypical "techies." Both are male in their 40's with a strong technological background. Both are doctoral students in the Educational Technology program. One of them had been a computer consultant and owner of a computer store. The other works as an engineer at a local broadcast service. The other two Techguides are female with a teaching background in literacy and language arts. They are both doctoral students in the Teacher Education program. They had little knowledge of technology. Two of the themes that surface in the following informal stories are role of the room in the development of the Techguide culture and the impact of this culture's interaction with the broader Teacher Education culture of the College.

Stories of the Techguides

Andrew Topper, Ph.D. student, Educational Psychology

I had started my fourth year in the Ph.D. program when I was asked by Dr. Zhao to coordinate and lead the Techguides. I worked closely with Dr. Zhao as he developed the ideas that became what I call "the shop", part of a new approach to supporting technology adoption in the MSU college of education. My own background is in computer science, with over thirteen years of experience as a software engineer, so I bring substantial technology experience to my work as a techguide.

I was one of the first people to occupy the room, working with a few other Techguides as we moved the desks and chairs into place and installed all the computer equipment. I feel a sense of belonging there and feel strongly that the room is a powerful and productive environment for learning about all aspects of educational technology. While I bring a wealth of technical expertise to this learning community, I am deeply interested in learning how technology shapes and is shaped by the practices of ordinary teachers. I enjoy working with TE instructors, as well as with students in the college, who bring teaching experiences I don't have to my attention and help me understand the complexities of classroom life and the challenges of using technology in pedagogically appropriate ways.

I think the thing that strikes me most about the ethos of the room is the way it supports a spectrum of social and intellectual activities. At various times during a single day, you might observe or participate in conversations about how to install specific software or hardware, work collaboratively to locate specific educational resources on the Web, discuss papers and presentations for conferences or journals, have philosophical or epistemological conversations about teaching, learning, and knowing, and engage in humorous story telling about personal experiences with technology. I believe the power of the room is in its' ability to support all these, and various other, forms of stimulating intellectual conversations that provide students and faculty alike with numerous opportunities to engage in meaning making around, with, and through technology. At its core, the shop is a social context for thinking, talking, working, and experimenting with various forms of educational technology that is supportive but challenging, critical but friendly, and at all times helpful to those who assemble there. One measure of how successful the room has been in cultivating an environment for educational technology research are number of people who inhabit it at all hours of the day or night.

The learning community that meets regularly in formal and informal ways in The Shop includes Techguides, TE instructors, classroom teachers, faculty members, undergraduate and graduate students. The learning that occurs in The Shop is at times intentional, and at other times incidental. We hold classes and workshops; we have social gatherings; we work collaboratively with teachers. Perhaps most importantly, we engage in a variety of ongoing scholarly activities that focus on the intersection of technology and teaching in The Shop.

I am thankful for the opportunities I have had to learn, laugh, talk, share, and know in The Shop and I hope to continue being an active member of The Shop as a techguide in the future. I am also interested in knowing more about why The Shop has been so successful as a learning community and what we might do to support similar efforts in other settings.

Andy's story highlights ways in which the environment of Room 130 is a supportive and challenging environment for a "techie." It also illustrates the way the room provides Andy with interactions with teachers and teacher educators which most likely would not be available to him without a place like this. But although the vigorous and varied ways that the room is used provides evidence that it supports a vital culture, it is not clear the extent to which that culture is indeed a newly developing culture combining the two groups introduced earlier—the techies and the teachers.

Rick Banghart, Ph.D. student, Educational Psychology

I call it "the room." (In an early meeting we decided that it was "The Shop" but the name hasn't stuck for me.) The room is the focus of activity for the Techguides. Although I'm not an official techguide (i.e., I don't hold a paid position), I feel like I'm part of the room. Becoming part of this group of people was my explicit goal at the beginning of the semester, and I feel that I have met my goal. I had been pursuing my Ph.D. in Educational Psychology for three years while working full time as an engineer at the University's public television station. For the first three years I enjoyed my classes and my colleagues, but I found that I was unable to find a place for myself as a scholar. Dropping in for classes and returning to work and home resulted in my lacking any sense of connection with the broader college community. The room has provided me a place in which to become a member of a community of scholars.

I think of the room as an ideal facility for a number of reasons. It is a six-minute walk from my office at the television facility, through a beautiful campus. The room has a high ceiling and windows on the east and west walls that extend from the ceiling to near the floor with views of trees and sky. The result is a large, airy space filled with natural light. The furniture consists of about a dozen desks with open shelving units on them. The technology in the room is very current. We are connected to a dual Pentium Pro NT Server with SQL Server and Internet Information Server. The workstations consist of a half-dozen Macintosh 7300s and five Pentium machines running Win 95. The college has made a commitment to providing software as needed. From

my perspective, these factors combine with the people with whom I am privileged to work to create a work environment that is ideal.

I see that Andy mentioned the ethos of the room. The word "ethos" had not entered our discussion of the environment until we started work on this paper, but its introduction to the discourse is appropriate. Unlike the typical graduate student cubicles, we work in a very open space. We intentionally make the room inviting to passers by. We regularly seek help from one another in all matters from the phrasing of a sentence, to the proper HTML tag syntax. The ethos that has evolved encourages us to be open with our knowledge and with our lack of knowledge.

My involvement in the room as a techguide has affected me in a number of ways. I might say that I've experienced an epistemological epiphany. I entered my Ph.D. program after being out of the academic field for nearly 20 years. When I was last learning about education, Piaget was just being integrated into the curriculum. Over the last three years I've been introduced to a wide range of ideas: post-modernist, socio-cultural, cultural-historical, Vygotsky, constructivism, constructionism, and evolutionary epistemology. Reading about such things brought about an intellectual understanding of these ideas, but the room is a place where all of these ideas can be experienced. Through the combination of learning the very technical processes of creating interactive Web-based learning environments, and helping others learn such technical skills, I've come to have a much deeper understanding of how knowledge is acquired and what knowledge is.

Early in the semester I embarked on a Web development project. My goal was to create a Web-based application that would allow students to store and graphically display data in support of a high-school physics class. Although I had some programming background, this project required the use of a number of technologies I had no experience with. As I began, I sought information and assistance from my colleagues, as well as from technical experts employed by the College. I quickly learned that the information I got in answer to my questions was very often wrong. At the same time, others regularly consulted me for technical assistance. I became acutely aware that I needed to be as skeptical about the "knowledge" I was giving others as I was about the knowledge I received from others. In a field where what was true yesterday is not true today, knowledge claims have to be qualified.

It is clear from Rick's story that the kinds of learning about technology afforded by the culture of this room are at least potentially transformative. In addition to the learning which Andy mentions as coming from interactions with teachers and teacher educators who bring a completely new set of perspectives, understandings and skills, the kinds of interactions among the residents of the room in themselves contribute to reflections about teaching and learning with technology.

This space seems to have great creative potential but it also erects barriers. Rick's statement that the Techguides have made a deliberate attempt to make the room welcoming to passersby indicates that the room is clearly techguide territory. Although the Techguides have attempted to make it a public space there are clear constraints to this. Although it may be a space that is comfortable under certain circumstances to non-techies, and although it may be used by a wide range of people for a wide range of purposes connecting technology to education, in fact it is not a public space. The room is locked for security purposes whenever a techguide is not present and individuals working in the room must be consciously identified as either insiders or outsiders in order to maintain the security of the room.

Kaijun Hou: Ph.D. student, Teacher Education

As a student of teacher education majoring in language teaching, I started my role as a techguide without much computer technology knowledge, but with strong interests and longing to learn about technology applications in language teaching and learning. I saw the promise of technology as making teaching and learning more creative, effective, efficient. But it was a big challenge for me.

Challenge #1: Entering the room: I entered the room as an outsider. I mean that the room was already occupied by some tech experts. I was hesitant to use some of the computers that they owned. Whenever I needed to use some computer, I would ask for permission. But, the answers I got made me feel welcome; I could use any computer if it was available. This made me feel that I was part of them. But being part of the Techguides was not only that I could use the computers in the room, there was something else.

Challenge #2: Entering the conversation: Just being in the room didn't make me part of the Techguides, even though I thought I was. I felt that they were standing on the mountain talking to me and that I couldn't hear clearly what they were saying. I had to make the effort in order to hear and understand what they were talking. Therefore, I stayed in the room more often and tried to join their conversations. I figured out that I came from a different discourse group. In order to be familiar with the discourse in the room, I needed to become familiar with the language and the knowledge base that they all used in the conversation. The conversations that I had with other experienced Techguides provided opportunities to construct knowledge together. Our talk ranged from basic software use to higher level discussions about technology and pedagogy, virtual communities, learning communities, technology and schools, and what teachers need with educational technologies. Like Andy, I am deeply interested in learning how technology shapes and is shaped by the practices of ordinary teachers.

It seems there were three stages to the process of becoming an insider:

1. Beginning techguide (a language teacher): During this period as a techguide, my conversations with other experienced Techguides was very basic, such as " How

can I find ...?" " How can I open...?" " What is ...?" At this moment, technology to me was still thought of as a tool. If I knew how to use the tool, that would be enough for me.

2. Intermediate techguide (a language teacher): During this period as a techguide, I grew a lot. I could join the conversation and begin to ask some more in depth questions, such as " How could I make it work this way?" " What could I do that I can make it better?" " Is there any other way to represent this idea?" " What are the possible ways that I could do to reach what I want?" Now, I could make connections with what I knew and what I would like to have happened in my work as a techguide.
3. Experienced techguide (a language teacher): Now, I could discuss with other Techguides how we could combine technology with teaching and learning. I worked with some TE instructors and interns. I could offer ideas on how and what technology could do in teaching and learning. These ongoing conversations stimulated my thinking about technology applications in education, broadening my knowledge base of educational technology.

The room and the conversation: Being in this room and being part of the conversation is challenging, exciting and stimulating. There is always something new evolving in this environment. Incidental and mediated learning always happens in here. I enjoy this community and the dialogue with all the people. It's really a learning environment. It's challenging in a sense that the new knowledge occurs any time and knowing the new knowledge is exciting and stimulating. This social matrix weaves diverse cultural backgrounds and knowledge together. This reminds me of Burbules' " Dialogue in Teaching." He believes that: "Dialogue is an activity directed toward discovery and new understanding, which stands to improve the knowledge, insight, or sensitivity of its participants. The pursuit of mutual understanding or agreement on some matter of common concern, therefore, does not necessarily threaten, and is not threatened by, difference. The key criterion to be applied here is whether understanding or agreement is achieved in ways that allow participants a full range of opportunities to question, challenge or demur from each other's view"(p.8).

Kaijun has experienced many of the same kinds of learning experiences from her participation in this environment as described by Andy and Rick, but in addition she suggests that there is a substantial insider-outsider issue even among the permanent inhabitants of the room, primarily based on technological expertise. This is an important issue, since previous descriptions of the techguides as "we" suggest a homogeneous solidarity which Kaijun's story breaks down. If insider/outsider groups exist even among the Techguides themselves it is interesting to wonder how this might facilitate or impede the new culture which the program is designed to engineer. Examining how those insider/outsider distinctions are broken down may provide insights into ways to help break down barriers that make teachers and teacher educators perceive themselves to be outsiders to a technology culture. Three important features emerge in Kaijun's journey from outsider to insider. First is her determination. She set herself a challenge to overcome the barriers to full participation in this culture. Second is Kaijun's identification of those barriers as her lack of technology skills and her lack of a common language for discourse with this group. So she set herself the task of learning the skills and the language. The third feature is the time and the authentic tasks that made it possible for her to function as a member of the culture. She had the time available to her to immerse herself in this culture, and she had work to do in common with the other members of the culture. It is difficult to imagine how she might have made the transition with any one of those pieces missing.

Sheri Rop, Ph.D. student, Teacher Education

I became a techguide this fall with very little technology experience. I was interested in the ways that technology could be thoughtfully used in classroom teaching, but e-mail and word processing were the extent of my experience. Like Kaijun, I experienced severe cultural discongruity, primarily focused on the room itself and the language of technology. I find this discussion interesting because I feel that issues of the constraints and affordances of physical space and materials are an important part of helping people become comfortable, competent, and thoughtful users of technology. I was happy to know that officially I "belonged" to Room 130 but I was definitely an outsider. As we began to set up the room, I noticed that the six spots by the windows were immediately occupied by the "experts." It took quite a while for the rest of the room to "gel"—it wasn't immediately clear who all the grad students were who were assigned to the room and all the furniture didn't arrive immediately—so a number of us were sort of "floating." Like Kaijun, in spite of all the words to the contrary I did not feel comfortable using someone else's computer and I did not have one to call my own. I also noticed that no one else really worried about us; those who had claimed a space set to work and we were left to fend for ourselves. I think this was a very valuable, although uncomfortable, time. It forced me to decide how to establish myself among this group.

As I began my work as a techguide I, like Kaijun, was continually challenged. I had entered a foreign country. When I needed help—which was pretty consistently at first—I felt that the other Techguides were speaking a foreign language. Learning the basic computer skills that I needed in those first weeks was the most intellectually jarring experience I have had. I had to learn from scratch a new language and a new way of thinking. I thought I had known from the time I was two years old what the preposi-

tion "in" meant. But when Andy said to me "You have to open the document in Netscape", all of my previous understandings of that word were defeated; I had no way to process what this might mean. I had to find my way through uncharted territory. The computer not only spoke a foreign language but was also a tyrant; either I did things its way with perfect precision or we had no interaction at all. Hand signals and rough approximations of words, standby tools of communication in foreign countries, were powerless.

This whole experience has given me valuable insight into the way teachers must be feeling faced with the pressure to incorporate technology into long-established patterns of classroom interactions. If I got stuck, I knew someone in Room 130 would be able and willing to help me out. I knew the resources available in the room in terms of people and equipment. How much more difficult for those who did not have, or were not familiar with these resources. However, I also felt guilty that I was taking up a lot of people's time. I countered this in my mind with the reminder that Dr. Zhao had stressed that we were all here to help each other—(although from my perspective there were only a few who really needed much help and no one who needed as much as I). I also reminded myself that I was probably a good test case for these technology experts—if they could be patient enough to work with me, they would be well prepared to work with the TE instructors who would be coming to us.

During this semester, I have gained a great deal of knowledge and confidence, but I have not become part of the culture of the room to the extent that Kaijun has. A big part of the reason, I believe, is the limited amount of time I am able to spend in the room. Since I live an hour and a half from the university I am only able to be on campus two days a week. Time to just "hang around" working on projects in the room seems vital to real membership in the culture.

The stages I have experienced haven't occurred for me in quite the same way as they did for Kaijun. I feel that I have passed the beginning stage. I have some pretty good basic skills and I have successfully learned the language, at least to a workable degree. These accomplishments make it possible for me to participate in what Kaijun identifies as stage three—participation in discourse about the ways that technology and teaching and learning intersect. However, I have not reached the stage of facility with technology that she describes in stage two, nor have I reached a point where I am comfortable helping a teacher use technology in his or her classroom, although comfort no longer seems to me to be a necessary qualification to initiate such a relationship.

These stories provide valuable commentary on issues of culture around technology. Barriers are revealed to be more permeable than might appear. While Techguides might seem to all be "techies" to outsiders, in fact they possess widely varying degrees of expertise and comfort with the culture of technology. Sheri's story reinforces the inferences drawn from Kaijun's story that participation in a culture of technology in education involves four factors: 1)determination, 2) skill with technology and the language of technology, 3) authentic tasks to work on, and 4) time to get comfortable with the technology and those who use it. It is clear that the room can support this process for the Techguides, and that it can provide a place for Techguides to interact with teachers and teacher educator in effective ways. However, Kaijun's and Sheri's stories raise the possibility that the extent to which the room helps to create and support a culture of technologically proficient individuals, it may inhibit the creation of a marginal group in which teachers and teacher educators can participate as equals; it is possible that the two purposes of the room work at cross-purposes with each other.

Summary

As the stories suggest, the four Techguides, with quite different backgrounds in technology and teaching, were able to (sometimes forced to) interact with each other to construct a shared culture of teaching and learning with technology. While we have not achieved the goal of developing a third group yet, representatives of the two traditionally separate groups—techies and teachers—have been drawn closer through this interaction in about three months. It is our expectation that this interaction will continue and the Techguides will continue to develop this new culture.

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Distance Collaboration and Technology Integration Between Two Institutions

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Collaboration is among the most discussed topics in education today. Teachers are being encouraged to collaborate with each other to improve instruction for their students. Most notably, collaborative efforts between both students and teachers work well with technology integration into the curriculum. In addition to the use of technology to enhance students' learning, technology can also be used to support teachers in the classroom.

Each Spring, Mary Washington College, located in Fredericksburg, Virginia, hosts a faculty workshop. The workshop is a part of Mary Washington College's Faculty Academy that provides a forum for faculty to share innovative teaching practices involving instructional technologies. In April 1997, we became involved in a Faculty Academy project called Collaborative Technology Integration (CTI). The project consisted of workshops that involved collaboration efforts between faculty members from Mary Washington College (MWC) and graduate students in instructional technology from West Virginia University (WVU), in Morgantown, West Virginia. The workshops were hosted by MWC and served to assist the faculty at the college in determining effective uses of technology in the curriculum.

The CTI project paired up individuals from the two schools to work together on the integration of technology into curriculum. Under the leadership of Dr. W. Michael Reed of WVU and Dr. David Ayersman of MWC, 10 MWC faculty and 10 WVU graduate students worked in pairs to facilitate technology integration efforts and to demonstrate the results of integration at the conclusion of the academy. To close the session, each pair presented the products they had produced and discussed the various points related to technology integration, the collaborative process, and the role that distance played.

The Collaborative Process

Most collaborative work consists of a group of individuals working on different aspects of the project. Usually, the group of individuals involved in the project are experts in one or more fields that deal with the content of the project. All of the individuals involved in the project are working together to arrive at the common goal of completing the task (Armstrong 1996).

MWC and WVU participants used a collaborative approach to integrate technology into the curriculum. In the CTI project, the collaborative group consisted of one MWC faculty member, who served as the content area specialist, and one WVU graduate student, who served as the instructional technology specialist. The two project leaders worked together to try to pair up individuals with similar interests whenever possible. Once the partners were determined, they were given the tasks of making the initial contacts and identifying curriculum needs. After the needs assessment, it was up to each instructional technology specialist to begin looking for various solutions to solve the problems. The partners worked together examining pre-integration syllabi and targeting areas for possible integration.

Because the participants were separated by quite a distance (260 miles, about 4 hours driving time), a face-to-face collaboration was not possible. To overcome the distance barrier, the partners of the project relied on e-mail, file transfer protocol (ftp), faxes, and the telephone to share ideas, works in progress, and ideas for future work. There was only one face-to-face meeting during the course of project. This meeting took place the day before final project presentations. In this meeting, the participants finalized plans for the presentations and ensured that the projects fulfilled the original vision. The final project resulted in a presentation to show the work completed by each group to each of the teams involved in each of the other groups.

Technology Integration in the Classroom

Several authors have described the integration of technology in the classroom. Bergeron and Bailin (1996) state that "in many instances, there is a need to educate authors and editors as to the possibilities of hypermedia...and the features of available authoring and editing tools" (p. 19). The instructional technology specialists, because of their experience and research in the area of hypermedia and technology in the classroom, served in this educational role. Armstrong (1996) lists three levels that

faculty must go through in order to thoroughly integrate technology into their curriculum.

The first level is the basic level. At this level, faculty use technology to help present their ideas to the classes. They often use presentation packages as another way of organizing and presenting the information to their classes.

In level two, the intermediate level, faculty expand on these basic packages and change them into something that is more interactive. Faculty work with instructional designers in the areas of storyboarding and multimedia incorporation to involve their students more in the use of hypermedia.

At level three, the advanced level, faculty refine their skills. They are now considered the experts, and will continue to incorporate hypermedia technology in their classes. Now, they are at the level where they can help the faculty members at level one.

This process is a very rigid, defined one. It assumes an abundance of on-site technical expertise, which is not always the case. In this particular project, there were more faculty members that wanted to learn about technology integration than there were experts in this area. For this reason, the program was set up for the benefit of both groups. The faculty benefited by being able to work one-on-one with an instructional technologist to implement computer technology into the classroom, while the graduate students benefited from the experience of working collaboratively. The distance was expected to be a complicating factor as well.

Computer Use in Education

Computers, when used effectively, can significantly enhance students' educational experience in many ways. Kern (1995) found that college French students who used a computer-mediated-communication program interacted in French more often and were more likely to make longer, more complicated expressions in French. Liu and Reed(1995) found that a hypermedia program incorporating sound, video, pictures, and other explanations was effective in helping college English as a second language students learn vocabulary. Moore (1988) found that computer-assisted instruction was effective in improving low-level math students' performance. In an overview of hypermedia and education studies across content areas, Burton, Moore, and Holmes (1995) concluded that hypermedia is at least as effective as conventional teaching methods, and sometimes more effective. It is more efficient than conventional methods in terms of time.

However, not all research has been as promising. In a review of the literature dealing with the effectiveness of computers in the social studies, Berson (1996) concludes that there is simply not enough research in this area, and encourages more. He advises teachers to wait until there is more research with positive results before investing a large amount of money and effort into CAI (Berson, 1996). In explaining the mixed reviews, Wang and Sleeman determine that "until the computer is viewed as an integral part of the educational process, rather than a separate instructional tool mainly for teaching computer literacy and programming, the learner will not have the full benefit of this instructional delivery system." (Wang & Sleeman, 1991, p. 343).

Prior Computer Use

The faculty members involved in the project had a variety of prior experiences with computers, ranging from programming skills to almost no involvement with computers. We assumed that the faculty members with more experience with computers would be more likely to integrate technology into their teaching, and that those with fewer experiences would be hesitant to integrate technology.

The Process and the Finished Projects

After the initial pairing, the instructional technologist made initial contact via e-mail with their faculty partners, who then provided syllabi from classes in which they wished to integrate technology. During the next six weeks, the participants communicated via e-mail, fax, telephone, and postal services to discuss the areas of the syllabus in which computer integration would be beneficial and to exchange materials used in the final product. Some of the faculty had already integrated computers into their curriculum, usually at Armstrong's level one (1996). These content specialists were seeking information from the instructional technologists to suggest further areas for integration. The instructional technologists created a variety of final products in order to meet the needs of the faculty members.

Roblyer (1997) states that for teachers to perform effectively as multimedia authors, they need to acquire knowledge and skill in instructional design as well as other things related to development. The instructional technologists brought their skill and experience in this area. The integration of technology in the curriculum will enhance the learning experience. Berson (1996) indicates that part of the problem with CAI is that it can be disruptive to the usual classroom proceedings. In order to avoid these problems and to integrate technology effectively, there must be a tight focus between technology and traditional methods.

The faculty academy provided this focus. Focusing on the issues of pedagogical innovation and education techniques, the academy expanded on the facilitation of learning and teaching experiences through applications of technology to school curricula and instruction.

Case Studies

The case studies that follow demonstrate two extreme examples that comprise the entire CTI project. In one case, the instructional technologist and the content area specialist had little contact over the time period, while the other project involved a team that was in almost daily contact with each other. When we looked at these two extremes along with the examination of the computer background experience instrument, it revealed that the content specialist who had

the most prior experience had the least amount of contact with his development partner. Conversely, the content area specialist who had little computer experience had high expectations for the possibility of using computers in his class.

Highly Interactive Collaboration: A Case Study

I initiated my first e-mail contact with John, an art professor, on March 17, 1997. I received a reply from a staff member, Shirley, explaining that John had just had surgery and that she would be working with me until he recuperated. Shirley faxed a message explaining John's prior experience with computers. In the message, John stated, "I have ideas of what might be done in my computer applicable studio art courses but not always enough knowledge and background to know how to do what I want." I quickly saw that John knew what he wanted to do, but he did not know exactly how to do it. I was encouraged that he had several ideas for this project. Along with this fax were syllabi for two courses into which he wished to integrate computer technology. I told him that he should pick the one in which he thought the students would benefit the most. John decided to emphasize the Color Theory course.

Later that day, I received another e-mail from Shirley which said, "I will be working with John and you on this project. I hope I can help you both!" Shirley was expressing her commitment to the project, along with John's, which reassured me. They wanted an interactive form of technology, and we clarified compatibility issues. The next day Shirley sent the problem statements for the class to me via Fed-Ex. Reviewing the materials helped me to get an idea of how the course was handled off line as well as giving me an orientation to the class material.

On April 23, John e-mailed that he has been "quite overwhelmed with sundry obligations over the past few weeks, and I don't see the end in sight....I'd like to make up for lost time." This exchange shows the level of commitment John had to the project, which is necessary for it to be completed. Shirley's commitment and interest were equal. On May 4 she expressed a great interest in interactive multimedia. Although our interests were not exactly the same, they complimented each other. The next step was to organize the material I had gathered. I integrated some of our ideas and sent the file electronically to both of them. Fortunately, they were "very impressed" with the first draft of the project.

On May 20, 1997 our first face-to-face meeting took place. During this meeting, we worked on several aspects of the project. We were able to work together to fine tune what I had previously sent to them and to incorporate a few more ideas. Together we reflected on the process in the final presentation and agreed that the collaborative experience was beneficial for all of us. John and Shirley had the content knowledge, and I had the technical expertise. They knew how to express their ideas visually, and I knew how to express ideas verbally.

Low Interactive Collaboration: A Case Study

I was invited to take part in the Faculty Academy at MWC. In the project, my advisor worked with a faculty member from MWC and arranged for teams to be created to integrate technology into curriculum. I looked forward to participating in the project because I would serve as a technology specialist.

I was paired with Dr. C, an MWC faculty member. We had little chance to discuss the project before the start of the academy as we had problems getting started. I e-mailed him to introduce myself and to make the initial contact prior to the workshop, but I received no response. After a period of about three weeks, I tried to make a second contact, but received no reply. After discussing the results of my contact attempts with the project coordinator, I was told that it was almost too late to take part in the workshop, so I made one final attempt to contact my partner. This attempt was successful.

I received an e-mail from my faculty partner containing a syllabus from a Sixteenth Century Studies course along with the URL (Uniform Resource Locator) for a technology integration project that he had previously tried to implement. His ideas for technology integration consisted of constructing a Web scrapbook, a place for students to put together ideas about what they had learned in the course (a knowledge construction approach).

After reviewing the syllabus I received, I took a look at the Web site address. Dr. C's first attempt at technology integration had resulted in an unfinished product. He reported that the project he started "was a one-third-of-the-way-through inspiration last time—by the way, you can see what's up of it now (not much, I'm afraid—I have all the materials but I haven't yet assembled them)." The Web site was just a start of what he wanted to do. The students were collecting Web resources that dealt with the sixteenth century and turning them in to him. Then, during his own time, he was taking those gathered resources and attempting to build a Web site to use in his teaching. Time was the issue in assembling them by the start of the Fall semester.

In the next e-mail message from Dr. C, he stated, "Jim, I'm behind on this: I have had the materials for about 4 months now—images, music, etc.—and I haven't yet put it all up, for a variety of reasons." He also informed me that he had purchased an HTML editor to assemble the materials. Dr. Carpenter welcomed any ideas from me and stated, "I'd like to work with you on designing a project like this one for my 16th-century studies class coming up this fall. Anything you can advise on regarding content, design, and *especially* how to pace the project through the semester (so I don't have a big bag of stuff I have to put together myself) would be most welcome."

It seemed that Michael was looking for ideas about how to incorporate some basic HTML (Hyper Text Markup Language) training into the syllabus so that students could

do some of the page design and assembly of on-line resources. Then, Dr. Carpenter could focus on fine-tuning the students' work. He had tried this approach with another class, but it was also incomplete. He stated, "In this case they've done a little more of the work than the 17th-century people did (I'm getting a little more experienced at this!)," but the need for basic HTML instruction resurfaced.

We had both used a commercial HTML editing package, but we felt it was a bit complicated for use in the class. The major problem was that he had a lot of materials, but didn't have time to put them all together. Teaching HTML seemed to be a good way to get student interaction by having them do the developing. I had previously taught beginning classes on HTML using a simple text editor along with a browser to view the results. My beginning sessions included a lesson that covered such topics as tags, heading sizes, images, and anchors. The whole session focused on a three-hour training session that could supplement his standard instruction. Michael stated "This sounds ideal! I'm very pleased. I did want to walk students through the basics of HTML, but I hadn't wanted to teach them a specific application (at least, not now)."

After receiving his response, I proceeded to develop materials in a presentation package. I felt that Dr. Carpenter could go over the presentation with his class for one three-hour period to teach his students the basics of HTML authoring. I put the presentation in a PDF (portable document format) file for distribution on the Web so that Michael could make the presentation available to students via his Web site. I suggested that he could start the teaching with the three-hour discussion and then follow up by providing the information on-line.

I e-mailed Dr. Carpenter with the attachments and he seemed pleased with what we had accomplished. Our technology integration plan consisted of one three-hour basic HTML authoring session for students who registered for his class. Without investing a lot of time or collaboration techniques, we were both happy with the outcome of our project. It seems that those who know most about technology do not require major technology integration.

Conclusions

In analyzing the communications and the processes of these two case studies, several themes were evident. We observed varying degrees of commitment to the project in both cases. The degree of commitment was related to the clarity of the vision for the project. In the high-interaction collaboration, the content specialist had a clear vision of the project from an early stage. This vision allowed the participants to retain their commitment to the project through the stress of other responsibilities. In the low-interaction project, because of a lack of vision of the project, it was easier to push the commitment to the project aside in favor of other commitments.

Communication was an important issue. In the high-interaction collaboration, the participants used various means of communication available. This interaction featured five faxes, numerous e-mail messages and numerous telephone calls. In the low-interaction collaboration, the participants e-mailed each other three times. The participant with little experience had a concrete idea of a project that would integrate technology, but required assistance in translating his idea into a program.

Due to the use of modern communications technology, distance was a non-issue. E-mail and faxes provided almost instantaneous feedback, and the telephone provided real-time communication. Only one technology that was anticipated to be helpful was not: videoconferencing. The lack of videoconferencing, however, did not have a detrimental effect on the collaborative process.

We discovered that, in spite of the different degrees of communication, each project had met the goal of technology integration into the target course, demonstrating that modern communications technology enables instructors to be able to tap into the knowledge of experts at different locations. This implication holds much promise for the future of technology integration into the classroom.

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Students, Learning, Assessment and Technology: A Campus-Wide Merger

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In an age when change is a norm, lifelong learning a critical mandate for prosperity, and technology a revolutionary force, transforming traditional practice is a central theme for Valley City State University (VCSU). VCSU faculty and staff assumed the responsibility for initiating and promoting change directed by the needs of learners. Faculty members from the teacher education unit not only altered their traditional practice, but stepped forward in significant ways to provide institutional leadership in developing the culture of innovation VCSU adopted several years ago.

Specifically, the VCSU goal is substantive reform of educational practice to improve learning and ensure success of students. In order to achieve the goal, the University (http://www.vcsu.nodak.edu) has implemented a comprehensive and multidimensional agenda for institutional change. A central component, Improving Learning with Technology (ILT), involves a powerful integration of learning and assessment that is facilitated by, and contingent upon, universal access to notebook computers.

Beginning with distribution of IBM notebook computers to all faculty in January of 1996 and to all students at the start of the 1996-97 academic year, VCSU became the first notebook university in North Dakota and one of a small number across the country. A sophisticated campus network connects offices and residence halls. Throughout the campus, classrooms have Internet access at every seat, as well as multimedia stations for student and faculty projects.

Specific features of the ILT innovations involve three aspects of the teacher education program: clear specification of abilities or outcomes; adaptation of a specific software package, Skill Command, for tracking learner progress on professional skills and abilities; and increased student responsibility for documenting performance through creation of an electronic portfolio. As a result of the ILT initiative, VCSU students:

- use the portfolio concept in the learning activities to document their progress (beginning with the first semester)
- demonstrate their progress through performance and use of the portfolio
- complete a portfolio for graduation from the teacher education program.

Teacher education faculty members and their students continue to provide service as leaders for the various initiatives at VCSU. *Technology and the New Professional Teacher; Preparing for the 21st Century Classroom,* a report from an NCATE Task Force on Technology and Teacher Education, recognized our Division of Education & Psychology. A letter our president received from Arthur Wise, President of NCATE states in part:

The report derives its credibility from the expertise of its members and their selection of exemplary practices to highlight. The task force cited a project at your institution as a case illustration. Your selection makes clear that you are at the cutting edge of teacher preparation practice. Your inclusion in our report should extend your influence and help change the norms of practice.

Through ILT, technology has provided VCSU faculty in the teacher education unit with a tremendous capacity to revolutionize education both on campus and for future students through dissemination of innovations in the public schools. Effective use of instructional technologies in a learner centered environment is providing new ways of learning in which access to information is virtually limitless, communication improved, learning more meaningful and fun, and motivation enhanced. Universal notebook computer access, classrooms with Internet connections, and state of the art multimedia resources combine to form the tool kit which faculty and students use to increase learning productivity, learning accountability, and preparation for professional careers that will extend into the next century.

Just putting the technology into the hands of all the students will not create significant gains in student learning, however. It is the use of technology in support of the clear specification of abilities or outcomes; adaptation of a specific software package for tracking learner progress on professional skills and abilities; and increased student responsibility for documenting performance that creates the powerful integration of learning and assessment. We believe this integration will revolutionize the quality and effectiveness of our students' learning.

The Plan

To realize this revolution, the faculty of Valley City State University have specified eight abilities that form the foundation for student projects which will become part of the Title III electronic portfolio project.

Eight Abilities for VCSU

Academic courses offered on campus will use performance assessment tasks that require students to demonstrate what they can *do* (ability to perform) and what they *know* (content knowledge). The abilities will be assessed in all areas of the curriculum, including general education courses as well as courses required in the teacher education program. These eight core abilities are:

1. Communication,
2. Aesthetic Responsiveness,
3. Problem Solving,
4. Effective Citizenship,
5. Global Perspective,
6. Collaboration,
7. Wellness,
8. Technology.

To support assessment of the eight abilities, SCANS (Secretary's Commission on Achieving Necessary Skills) research has been integrated into the VCSU model. The SCANS research identified 37 skills considered essential for workplace and school success. The VCSU model includes specific SCANS skills within each of the eight abilities. Students will be responsible for demonstrating two different SCANS skills from each of the eight categories. Each student will document achievement of the SCANS skills through the production of an electronic portfolio that will be required for graduation from the teacher education program.

The Communication ability refers to applying skills of writing, reading, speaking, listening, using media, and using quantified data. Four levels of achievement are defined: Level 1: Demonstrates knowledge of vocabulary, principles, and criteria of effective communication. Level 2: Demonstrates ability to read and listen critically, and demonstrates literacy in written, oral, and quantitative communication. Level 3: Demonstrates communication that integrates information from multiple disciplines. Level 4: Analyzes own strengths and weaknesses as a communicator. The SCANS skills for communications are Reading, Writing, Arithmetic, Mathematics, Listening, Speaking, and Visualization.

Aesthetic Responsiveness levels are: Level 1: Articulates a personal response (such as a journal or sketchbook) to artistic work. Level 2: Explains how personal experience, exposure, and formal factors (vocabulary) shape one's own response to artistic work. Level 3: Demonstrates an understanding of the historical, societal and cultural context of artistic work. Level 4: Based on acquired knowledge and experience demonstrates the ability to analyze and evaluate artistic work. SCANS skills identified for Aesthetic Responsiveness are Writing, Mathematics, Listening, Speaking, and Visualization.

Problem Solving and Decision Making levels are: Level 1: Demonstrates understanding of own problem solving process. Level 2: Develops understanding of specific strategies used in different disciplines to identify and solve problems. Level 3: Designs appropriate frameworks and strategies to solve problems. Level 4: Implements and evaluates solutions to problems in new situations. SCANS skills identified for Problem Solving are Creative Thinking, Decision Making, Problem Solving, and Reasoning.

Effective Citizenship levels are: Level 1: Assesses own knowledge and skills necessary for understanding local issues. Level 2: Participates in the decision-making process related to community issues. Level 3: Evaluates organizational structures and collaborates with others to facilitate achievement of mutual goals. Level 4: Applies developing citizenship skills to a community setting. SCANS skills identified for Citizenship are Teaches Others, Exhibits Leadership, Works With Diversity, Understands Systems, and Monitors Systems.

Global Perspective levels are: Level 1: Assesses own knowledge and skills in thinking about global concerns. Level 2: Analyzes global issues from multiple perspectives. Level 3: Demonstrates understanding of connections between local and global issues. Level 4: Applies strategies in forming a response to local and global issues. The SCANS skills for this ability are the same as those for Effective Citizenship.

Collaboration and Wellness levels are: Level 1: Observes and assesses own behavior patterns in working with a task-oriented group. Level 2: Develops an understanding of behavior patterns of others in social situations. Level 3: Demonstrates the ability to communicate and work cooperatively within a group. Level 4: Demonstrates the ability to work toward a common goal as a team member. SCANS skills for Collaboration and Wellness are Responsibility, Sociability, Participates/Team, Self-Worth, and Self-Management.

Technology levels are: Level 1: Knows available technology, follows proper procedures; Level 2: Understands requirements of the task, Manipulates technology for desired results; Level 3: Analyzes task/technology relationships, proposes simple technological solutions; Level 4:

Integrates systems technology, interprets/evaluates results. Technology SCANS skills are Acquires Information, Organizes Information, Selects Technology, and Applies Technology.

SCANS Skills

Under the SCANS skills, performance indicators were developed to help clarify what was expected at each level. Students will be responsible for demonstrating two different SCANS skills under each of the five categories. The performance indicators dictate how these skills can be demonstrated. A sample of the performance indicators selected for use at VCSU include:

Writing. Students must show their performance through the use of processes (such as brainstorming, outlining, or clustering); writing concisely and clearly; adjusting for different purposes; correcting information (through checking, editing, and revising); and using appropriate form, grammar, spelling and punctuation.

Mathematics. Students must show consistent accuracy and the ability to make decisions and predictions using mathematical processes

Listening. Students receive, interpret and respond to verbal and nonverbal cues, clarify, paraphrase, and model attentive behavior.

Speaking. Students understand purpose of communication and are able to identify the audience to receive communication, effectively organize ideas, clearly convey messages using verbal languages, use appropriate body language to convey messages, provide vivid and powerful detail, and respond with ease and confidence to audience reactions.

Creative Thinking. Students see all parts of the issue, explore a broad range of possibilities, consider possibilities from outside of the normal, consider futuristic possibilities, challenge assumptions, and take best elements from a broad range of possibilities.

Decision Making. Students begin with well-defined objective, set criteria for attaining objective, identify possible barriers, identify possible risks, identify probable consequences, consider multiple alternatives, and select and alternative that meets established criteria.

Problem Solving. Students identify the problems, examine all probable causes of problems, implement decision-making strategies, monitor progress of proposed solution, adjust alternatives when necessary, and revise plan as indicated by the findings.

Reasoning. Students use logic to examine issues, consider the source of information, challenge assumptions that underlie the issues, analyze the relationships, and generate theoretical conclusions based on logic.

In developing a plan for implementing the SCANS skills across campus, it was decided that a software program would be selected to help record and measure the performance of these skills. VCSU worked closely with ADVANCE Education Spectrums to develop a software package that would be user friendly and would have the ability for students to access and monitor their own progress. A software package that is capable of allowing teachers to create a learner tree with individual names or teams and the activities they must perform to demonstrate competency of a given skills was developed.

The learner has access to view the learner tree but only the instructor that created the tree has access to create milestones showing competencies. The instructor can define the number of skills that are assessed, and the date it was assessed. The learner can quickly check to see what milestones were awarded. New skills assessments can be generated if needed.

An Example

In Education 315, Math in the Elementary School, students are required to create their own personal Web Page. Each student includes a homepage, pictures and graphics downloaded from the Internet, a personal information page, lesson [illegible]ey have created, lessons discovered on the Intern[illegible]nks to problem solving, place value, NCTM Standards, and information they have learned in the course. All of this information is organized in their home page with links from their table of contents. This project is designed to meet the technology ability with specific reference to the SCANS skill of organizing information.

In Education 322, Methods and Materials of Language Arts I, students are required to prepare an electronic portfolio using the presentation software PowerPoint. The portfolio includes a table of contents with buttons, scanned pictures, digitized movies of lessons taught, a personal page, and examples of what students have learned in the course.

The ability demonstrated in this project is Problem Solving. The SCANS skills included in this ability are decision making and getting information. Students provide an introduction on how they met this ability and give specific examples of how they met the SCANS skills. They include teaching examples and how they used decision making skills to determine what to include in the portfolio.

Conclusion

This plan is still in a very fluid state. We believe that it will always be in a fluid state. We are trying to create a culture that can and will adapt quickly to new demands and opportunities. If we were to report on this plan next year you would see many changes in it. The students have responded to the changes and the direction, for the most part, in a positive vein. An on-campus survey conducted by Dr. Kathryn Holleque reported that the majority of the students were satisfied and felt the increase in tuition was merited.

We believe that through the use of ubiquitous technology, the student will find it appealing and satisfying to take charge of their portfolio and thereby their own learning. We believe that only when the student learns to self assess and

make personal decisions on how to improve performance will we have students with the initiative and ability to succeed in a world where change is a constant and life seems to be reinvented every few years.

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Empowering Faculty with Technology

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Established in July of 1996, the Center for Instructional Design and Delivery (CIDD) of the University of South Dakota (USD) has as its main focus the training of USD faculty and staff to optimize the application of technological resources in their daily activities. In its third semester of existence and second semester of training activity, the CIDD program has changed to better serve USD faculty needs.

Progressing from an initial situation in which the Center had to borrow facilities from the academic units of the university to deliver its training, CIDD now has a state-of-the-art facility with a broad variety of technological resources in terms of software and hardware. To deliver the training program, CIDD incorporates diverse USD internal human resources, utilizing guest speakers from various academic units. Depending upon the topic of the training, the characteristics of the trainee group, and the skills available from the pool of potential visiting experts, the guest speaker might be, representing disciplines from Arts and Sciences, Business, Education, Fine Arts, Law, and Medicine. This situation has turned out to be win-win; the trainee faculty see by the visiting scholars' diversity that technology is widely used and widely necessary in education. The visiting scholars also derive a great deal of satisfaction from being able to contribute to the university-wide upgrading of computer skills without having to take a significant amount of time from their schedules.

For direction, curriculum development, and academic integrity, CIDD has added a half-time tenure-track faculty member whose forte is instructional design and delivery. To schedule and hold training sessions for USD faculty, staff, and students, an instructional coordinator has also been hired. At the present time, CIDD personnel number fourteen:

- Two co-directors, representing support services and academia
- Instructional design and delivery specialist (half-time)
- Instructional coordinator
- Graphics designer/multimedia production specialist
- Photographer
- Videography/digital audio/audio production specialist
- Administrative assistant/smart classrooms technician
- Electronics technician
- Senior secretary
- Four graduate assistants

There are two distinct training opportunities offered at CIDD. The first is general training sessions open to the entire campus. The second, and the focus of this paper, is daily training sessions for selected USD faculty. Each semester, the deans of each academic unit at USD indicate two teachers to be trained at CIDD. These trainee faculty have become known as the CIDD faculty and attend, in groups of a maximum of twelve per semester, a training program of ten hours per week. In order to accomplish this, faculty need release time from their normal workload. During the first semester of training sessions, CIDD faculty were released from 50% of their workload by their deans, CIDD funding half of the release time and the sponsoring academic unit assuming the other half. In this, the second semester of training, CIDD is no longer funding release time and, consequently, CIDD faculty receive only 25% relief from their normal work load.

Planning

The ten-hour-a-week training program for CIDD faculty is based on the broad goal of the CIDD training, which is to enable USD faculty and staff to optimize the application of technology in their daily professional activities. Having instructional design as unifying theme, CIDD offered, in the first semester of the 1997/98 academic year, thirteen weeks of training, each focusing on one specific technology with potential instructional application. After one week of classes on the foundations of instructional design, the weekly subjects included, among others, web page development, PowerPoint, PhotoShop, video/audio, distance learning, and multimedia production. On the first day of each new week, the instructional value and potential applications of the coming instructional technology theme were discussed.

The faculty involved were to fulfill six CIDD expectations:

1. design or modify one course during the semester,
2. serve as a liaison between the CIDD and their academic units,
3. attend training sessions offered by the CIDD,
4. present their CIDD projects to their sponsoring entity,
5. provide advice and/or assistance in the design, development, and maintenance of the CIDD home page, and
6. assist the CIDD in the pursuit of grant funding.

In order to help faculty accomplish this goal, laboratory sessions where they could get individual assistance and work on individual projects were offered in addition to the technology-oriented training sessions.

Evaluation

At the beginning of the semester, the CIDD faculty completed an attitudinal survey investigating their attitude towards the use of technology. The survey items were derived from other attitudinal survey instruments and items were added to adapt the instrument to the USD and CIDD goals. A computer program was written to allow the CIDD faculty to do the survey on-line, thus reinforcing the idea that data capture and analysis through technology is more efficient.

Table 1.
Technology Attitudinal Survey

	Strongly Disagree	Disagree	Un-decided	Agree	Strongly Agree
Questions	**SD**	**D**	**U**	**A**	**SA**
1. Computers are likable	1		2	2	2
2. Computers are friendly		1	2	3	1
3. Use of computers is good			1	4	2
4. Using computer is pleasant			3	2	2
5. Using computer reduces stress		4	2		1
6. Using computer is comfortable		2	2	2	1
7. Using computer is natural		3		3	1
8. Using computer is fulfilling		1	1	2	3
9. Using computer is exciting			1	2	4
10. Using computer is invigorating		1	2	1	3
11. To me, E-mail is familiar				2	5
12. To me, E-mail is relevant				1	6
13. To me, E-mail is interesting			1	3	3
14. To me, E-mail is valuable				2	5
15. To me, E-mail is needed				1	6
16. To me, E-mail is appealing			2	1	4
17. For my students, E-mail is familiar			1	6	
18. For my students, E-mail is relevant			1	3	3
19. For my students, E-mail is interesting			1	6	
20. For my students, E-mail is valuable				3	4
21. For my students, E-mail is needed			1	3	3
22. For my students, E-mail is appealing		1	2	4	
23. To me, WWW is familiar				4	3
24. To me, WWW is relevant				1	6
25. To me, WWW is interesting				1	6
26. To me, WWW is valuable				1	6
27. To me, WWW is needed				2	5
28. To me, WWW is appealing			2	1	4
29. For my students, WWW is familiar			2	4	1
30. For my students, WWW is relevant		1	3	3	
31. For my students, WWW is interesting			1	4	2
32. For my students, WWW is valuable				4	3
33. For my students, WWW is needed			1	3	3
34. For my students, WWW is appealing				5	2
35. To me, Multimedia is familiar		1	2	3	1
36. To me, Multimedia is relevant			1	3	3
37. To me, Multimedia is interesting				3	4
38. To me, Multimedia is valuable			2	2	3
39. To me, Multimedia is needed			1	3	3
40. To me, Multimedia is appealing			2	2	3
41. For my students, Multimedia is familiar		2	1	3	1
42. For my students, Multimedia is relevant		1	1	3	2
43. For my students, Multimedia is interesting			2	2	3
44. For my students, Multimedia is valuable			2	2	3
45. For my students, Multimedia is needed			2	2	3
46. For my students, Multimedia is appealing			3	2	2
47. To me, using computers for my productivity is familiar				2	5
48. To me, using computers for my productivity is relevant				1	6
49. To me, using computers for my productivity is interesting				2	5
50. To me, using computers for my productivity is valuable				1	6
51. To me, using computers for my productivity is needed				2	5
52. To me, using computers for my productivity is appealing			1	2	4
53. For my students, teachers' use of computers in the classroom is familiar		3		4	
54. For my students, teachers' use of computers in the classroom is relevant			1	4	2
55. For my students, teachers' use of computers in the classroom is interesting			1	4	2
56. For my students, teachers' use of computers in the classroom is valuable			1	4	2
57. For my students, teachers' use of computers in the classroom is needed			3	1	3
58. For my students, teachers' use of computers in the classroom is appealing			3	1	3
Total		20	61	147	177
Percentage		- 5%	15%	36%	44%

The results of the survey show that the CIDD faculty overwhelmingly agree that using technology in their professional activities is relevant, necessary, and appealing, both for them and for their students. The only remarkable dissension from this opinion comes in the question about computer use reducing stress; by a large majority, the respondents disagreed.

In order to evaluate the work of the current semester and provide bases for future changes, the CIDD faculty members completed an evaluation form every week before starting a new theme. Seven questions were asked, once again on-line, this time formatted in a word processing template to allow more flexibility for the "essay" answers:

1. How many of the five sessions have you attended?
2. Please list the subject(s) covered.
3. What you would like to have had more of?
4. What you would like to have had less of?
5. The content covered satisfied your
   a. needs,
   b. expectations.
6. The instructor
   a. knew the subject;
   b. gave clear explanations;
   c. presented the material in an interesting way;
   d. used appropriate techniques;
   e. was fair;
7. Please make whatever additional comments you think might be helpful.

The most frequent comment/complaint was that there was too much lecture and discussion and not enough hands-on work. The participants wanted to begin producing something in the first class and pick up the theory inductively, or not at all. Perhaps because all of the participants were professional educators and had therefore already assimilated an amount of instructional theory, they objection to talking about instruction instead of creating some. Another frustration manifested by the participants was that they needed both instruction and time to complete their individual projects, and ten hours a week was not enough time to absorb the former and finish the latter.

Replanning

Based on analysis of the trainee faculty's evaluation of the course, evaluation of the participating faculty members' work, and dialogue with participants in training sessions, an evolution of the model is being implemented. CIDD has established a Technology Enrichment Grant (TEG). Any USD faculty is eligible to apply for a grant that allows the recipient to become a CIDD faculty member for one semester and pays up to $300.00 for supplies. The grant is for the design of a specific new course or the redesigning of an existing course. The target course is defined by name, proposed effect, means of evaluation, and expected date of implementation in the grant application.

The outcome of this modification will be twofold: to make CIDD instruction more hands-on and project-specific and to provide increased opportunities for participation. USD faculty may now enter the CIDD program by 1) obtaining release time from their dean or chair, 2) applying for a TEG, and 3) buying release time through a USD faculty development program grant. An important aspect of the modification is to make becoming CIDD faculty a voluntary decision of the individual faculty member rather than an administrative decision by the dean or chair.

Summary

The Center for Instructional Design and Delivery (CIDD) at the University of South Dakota (USD) is the result of a university initiative to direct resources into modernizing course design and delivery through technology. After two semesters of training USD faculty to incorporate technology into their teaching and research activities, CIDD is using feedback from the participants to modify the program to better satisfy both the requirements of the university and the perceived needs of the trainee faculty.

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GRADUATE AND IN-SERVICE EDUCATION

Section Editors:

Francis J. Ryan, *La Salle University*
Maryanne R. Bednar, *La Salle University*
John J. Sweeder, *La Salle University*

As we move rapidly into the 21st Century, it is becoming increasingly clear that educational technology is not a classroom frill, but is indeed an integral component of effective instruction. We have moved dramatically from the lantern slides of the 1930s, to the overhead transparencies of the 50s, and the Dukane sound/filmstrip projector of the 1960s. Now elementary school children use interactive computer software to probe the digestive system of the frog, and secondary students use the Internet to research interpretations of Hamlet's key soliloquies.

Despite these advances, some teachers are just beginning to wade, and some rather tentatively, into the mainstream of current educational technology. For these teachers, as well for those who have been surfing the net for years, in-service and graduate instruction remains essential.

Gunns engaging description of the two-year TEEM project provides an example of a positive and innovative telecommunication and multimedia in-service program involving twenty-four teachers from six different school districts in Arizona. She discusses how the TEEM project members developed a CD-ROM which houses a bibliography, lesson plans, and student-centered multimedia presentations. Using *The Oregon Trail* software package, Smith-Gratto and Fisher demonstrate how school curriculum standards across disciplines (language arts, social studies, and science) can effectively met. Swinsky suggests a variety of on-line resources and activities to guide novice Internet surfers. In *Drivers' Ed for Teachers Navigating the Superhighway*, Owens, Magouan, Eaton, and Smith assess the effectiveness of a statewide teacher in-service program using the Internet. Out in the islands, Hochenberger describe an in-service program she uses on the Marshall Islands that may serve as a useful template for other small, and perhaps geographically isolated, schools. Brownell and Brownell present a snapshot of their six semester-hour summer experience integrating technology, problem-solving, and curriculum.

Blakeslee, Ferris, Roberts and Yoder analyze the problems they encountered with *Launching an Internet-Based Master's Degree in Technology and Education*. As more institutions and agencies of higher education contemplate alternative delivery formats, such insights may help us from reinventing the wheel. Corry and Lynch provide a thoughtful five-stage plan for marketing distance education. Meadows, Aversman, and Lowery present an overview of a computer technology certification program to address new Virginia State Standards of Learning competencies.

Faculty development is often problematic. Milligan and Robinson's thoughtful article showcases how critical faculty technology development can be implemented using technology-literate students. They report one major obstacle to success: lack of faculty time and commitment to practice skills being developed. Kajs describes how a university, through its instructional and technical resources, and through the process of collaboration between university faculty and teacher-mentors, can facilitate lifelong learning for both teacher- mentors as well as beginning teachers. Hoping to create teacher technology evangelists, Jones and Shelton provide a guide for staff development based upon the three *I* words: incentives, inventive, and important.

On a different note, Rice's provocative article asks us to re-examine how we perceive others' thoughts when they are a *known anonymity*; whereas, Casey re-exams early literacy and technology.

Inservice to Practice: A Professional Development Technology Project

Cathy Gunn
Northern Arizona University

A telecommunications and multimedia inservice project sponsored by the Center for Excellence in Education at Northern Arizona University and by the US West Foundation included the study of an evolving professional development venture that connected university-based preparation with ongoing education of teachers. Twenty-four teachers from six geographically diverse regions of northern Arizona—from rural Reservation to agricultural valley to mountain community—participated in the Telecommunications, Environmental Education, and Multimedia (TEEM) project. The two-year TEEM project was funded July, 1995 through June, 1997; however, the partnership between participants—K-12, university, and community—extends beyond the funding period.

The Project: A Description

A non-reader student at our school with emotional difficulties one morning wandered by my monitor as I was demonstrating some Web pages that dealt with sports....Jose came by and looked at the screen and said, 'What are they doin?' Jose began to notice that students were engaged with a computer that required reading, yet had 'cool' stuff on it. Jose then wanted to know what other stuff could I find out about on the Internet. As soon as the other children left we both sat down and began our journey. I asked Jose what interested him and what hobbies did he have. Jose told me he really liked Lowrider cars. So we punched in the word Lowrider...and found a plethora of information....We then began to download pictures and text for him to take home to read. Jose was astounded at the information that was available that concerned his culture and hobbies...Upon further exploring of the Web pages Jose stated that he could not read what was on a lot of the screen. However, Jose himself noted the importance of reading this day....Jose has just finished the fourth grade and is well on his way in becoming a reader and an expert on Lowriders. [Susan, teacher participant journal]

Project Participants: Teacher Teams

A telecommunications and multimedia inservice project sponsored by the Center for Excellence in Education (CEE) at Northern Arizona University (NAU) and by the US West Foundation included the study of an evolving professional development venture that connected university-based preparation with ongoing education of teachers. Twenty-four teachers from six geographically diverse regions of northern Arizona—from rural Reservation to agricultural valley to mountain community—participated in the Telecommunications, Environmental Education, and Multimedia (TEEM) project. All twenty-four participants were K-12 teachers, with a mix divided almost equally among elementary, middle school and high school in six different school districts in northern Arizona. A TEEM Advisory Board consisted of an NAU biology professor, a middle school principal, a high school teacher, and representatives from Wupatki National Monument, Red Rock State Park, the Museum of Northern Arizona, NAU's Institute for Native Americans, the United States Geological Survey, The Flagstaff Arboretum, and the Audubon Society. The two-year TEEM project was funded July, 1995 through June, 1997; however, the partnership between participants—K-12, university, and community—extends beyond the funding period.

Project Content: Standards, Multimedia and Telecommunications

National standards (Appendix 1) in geography, math and the arts (music, drama and visual arts) were brought together with Arizona Department of Education environmental education (EE) guidelines (Appendix 2 & 3) in this project to address concerns that schools should be developing and using coherent integrated curriculums. State EE guidelines were chosen in an effort to increase teacher attention to promoting and maintaining a sustainable future. Integration of the content areas of geography, math and the arts fulfilled a need to integrate an area such as environmental education across diverse curriculum content. This unusual marriage of disciplines presented a real-world problem for teachers as they investigated their own practice and worked towards an integrated curriculum in their classrooms. Multimedia and telecommunications technologies were naturals in support-

ing integrated curriculum development and in supporting this developing community of teachers from diverse, rural and remote locations.

Teachers in the project were introduced to multimedia components: still video cameras, scanners, presentation software, projection devices, and the use of these components integrated into K-12 curriculum. They were also introduced to telecommunications: e-mail, LISTSERVS, the World Wide Web, creation of Web pages, Web page design, and integration of Web-based resources in K-12 classrooms.

Teacher teams developed EE lessons and instructional multimedia modules based on an environmental waste material theme. Teachers worked with instructional design specialists, programmers, artists, and content-area specialists to develop classroom lessons, activities, products, and resources. Modules were linked and have been reproduced on a CD-ROM to provide resources for participant teams for inservice purposes in their schools and in CEE's teacher education program.

Work in Progress: A Teacher-developed CD-ROM

The CD consists of introductions to telecommunications, multimedia, curriculum integration, using one computer in a classroom, assessing student multimedia projects, on-line search strategies, background information on the change process and equity issues. National standards in math, geography, music, drama and art, as well as Arizona environmental education standards are found on the CD (Appendix 4). The CD houses an extensive bibliography, thirty-one lesson plans or activities, samples of student-created multimedia presentations, and profiles the project members. Each lesson plan or activity has links to related national or state standards and are cross-referenced throughout the CD (Appendix 5). Through search strategies or by menu, a teacher can locate lessons related to math, lessons about or using composting, or all lessons related to a specific environmental goal (or national standard). Lessons are also linked to informational resources, such as "Multimedia How-To" (Appendix 6) or "Telecommunications How-To" (Appendix 7) if there is a multimedia or telecommunications component to the lesson. Related video clips, student presentations, or background information are also available as links to lessons.

All lessons are also linked to actual Web pages which have been "whacked" with WebWhacker software through two levels to illustrate how the Web can be integrated into the teaching and learning process. For example, "Protect our Planet," a play written by an elementary class, has links to a playwright interview, information on another environmental play, and a Web page on how to assess students in drama (Appendix 8). A middle school lesson titled "Garbage Graphing" includes links to a student-produced landfill presentation on PowerPoint software, an on-line graphing lesson, and information on solid waste management (Appendices 9-10). Because it contains a telecommunications and a multimedia component, the lesson is also linked to "Telecommunications How-To" and "Multimedia How-To" pages. The telecommunications and multimedia how-to pages include introductions to the topic in scenario format, photos of equipment, a video clip on how to scan materials for digitizing, examples of multimedia presentations, scanned student art work with accompanying audio explanations, and video clips of teachers talking about how the use of computers might enhance student learning. Lessons, standards, and text around highlighted issues can be printed for teacher use.

A World Wide Web home-page linked to resource locations has been set up as a repository for developed inservice modules. This Web page is under construction and is one method for continuing the project outcomes beyond the funding cycle.

In the second year of the project, teacher-participant teams planned and provided nine hours of professional development inservice to their peers using the CD-ROM disc to begin development of school-wide integrated environmental education plans, with inservice also emphasizing telecommunications and multimedia technology applications.

The CD-ROM disc is not just a how-to guide on integrating technology with teaching. Participants have included modeling through examples which exemplify true integration. For example, a user of the CD can choose to view a PowerPoint presentation created by a combined 2nd/3rd grade classroom of a field trip to a landfill and the process they used to collect data at the site (Appendix 11) or read a scenario which describes a multimedia-supported classroom (Appendix 12). Lessons can be accessed on the CD which are linked to state and national standards, to supporting information such as how to use multimedia or telecommunications in the lesson, and to Web sites which support the lesson. Preservice students should benefit from the integration modeling found on the CD as it is used in methods courses at the university.

The CD-ROM disc has been made available to the participating schools, to the US West Foundation, and to the Center for Excellence in Education for use in its teacher preparation program. Information from the CD is also available at the project Web site available at http://www.nau.edu./~cee/environ.html.

Attention to Process

To provide as much local support as possible, teachers were visited in their school locations several times throughout the project to tailor inservice to their specific needs. For example, an undergraduate student in NAU's engineering program was hired to visit each school site and to engage in

a needs assessment for connectivity. This student talked with teachers, administrators, and district technology experts. He was able to provide detailed plans for connectivity when needed, and in some cases, was able to physically connect a teacher for telecommunications access. The technical project staff person also visited schools and helped them locate unused multimedia-related equipment, such as a scanner, or helped teachers and administrators determine what equipment might be purchased.

As a result of [our] participation in the project, I have seen both staff and students grow in their knowledge and experience with multimedia. What is even more exciting is that I have seen these people share their knowledge and experience with others....One of our school's student artists produced a line drawing of a hornet, the school's mascot, which was then scanned. The scanned image was colored with PhotoShop by our principal, who then submitted it to the architect. It is now on the newly constructed football field's artificial turf and looks awesome. Before the project, we didn't have the equipment, software, or know-how to do this. [Joan, teacher participant journal]

Joan's school had purchased a scanner several years before the project, but as is typical in many schools, the person responsible for purchasing the equipment moved on and the scanner was moved to a closet. The TEEM technical staff found the scanner without software, worked with the principal on determining software needs, completed the software order, installed it, and provided training to teachers and administrators on the use of the scanner. Unintended outcomes, such as the mascot drawing above, show that the project went beyond our original plans. While not directly connected to integration, the enthusiasm generated by project participants led others, including school administrators, to begin using technical resources.

The project director met with teacher teams at their school sites after on-campus instructional workshops to apply what was learned in a university computer lab to their own individual situations.

I learned because I was given an opportunity to explore without pressure. That is how we learn, that is why I provided the same opportunities with teachers, students and parents. [Ellen, teacher participant journal]

Teacher teams met face-to-face three to four times a year on the NAU campus and met electronically through a project LISTSERV administered at NAU. Three of six participant school districts were located in remote regions in the Navajo Nation with ten out of twenty-four TEEM participants living locally. The project design included several on-campus seminars, but a majority of the work was done via e-mail and LISTSERV discussions. The Navajo Nation is approximately the size of West Virginia, with a population of 150,000-200,000. To be able to connect teachers and students within the Reservation schools, but also to extend a cultural exchange to teachers and students in communities outside of the Reservation, was an extraordinary boost to the participating teachers and their students.

Teacher participants were encouraged from the beginning to take ownership in the process. "What do you need?" was a question teachers needed to answer frequently. Planning for the CD may have been the most difficult part of the project. A mock-up of what a CD might look like was presented several times in the first six months of the project, but teachers were responsible for the content and for how the CD would look and work. This involved several brainstorming sessions with both large and small groups to work through the process. Teacher participants were not comfortable with taking the lead on the direction or content. To facilitate this, a workshop was held to address change theory and stages of concern. When teacher participants realized the CD could be called a "Work in Progress" and that they could collaborate, each with individual talents contributing to the whole (as opposed to having to become an expert in all areas), references to the project became "our project" rather than "your project." At this point in the process, teachers began directing, forming work groups, and they took responsibility for the final product.

There was a measure of pride and humility that accompanied this experience. It was awesome to ride on the coat tails of such an accomplished group of people. [Denise, teacher participant journal]

Addressing the Change Process

An unintended outcome of this project has been the development of strategies to address the change process when teachers are introduced to technology innovations and information about change was included on the CD to help teachers address this (Appendices 13-14). A turning point six months into the project came from the use of innovation continua with teachers determining both self and group movement or change on a continuum for each innovation (Appendix 15). A continuum was developed for each innovation (i.e., telecommunications access, project LISTSERV, integration of EE standards). A continuum indicated non-use or introduction in a column on the left to a full implementation column on the right. The use of these continua throughout the project brought teachers together as a working group.

Once the innovation continua were introduced graphically and used by teachers personally to mark their progress, they began asking for other continua to be developed later in the project. For example, during a summer 1996 workshop, a group of participants developed their own continuum to show progress in developing environmental lessons for the CD-ROM. Wall size posters of project tasks and training topics (e.g., progress in learning to use presentation software, develop Web pages, conceptual design of CD-ROM) for workshops were created and used periodically to show group progress. Whole-group debriefing sessions

centered on these wall posters to guide the next day's work. Colored post-its were used as markers and were moved by participants to indicate a group consensus of progress. Discussion established that while individuals might have moved up on levels of use, group growth reflected a definite location on the continuum with some individuals seen as outlyers. Teacher participants commented on this sense of community:

Most teachers that boast of twenty years experience feel that they have mastered teaching and are experts in molding young minds. My heart and knowledge have shown me otherwise....I thought it would be fun for the children to write their poems on the computer, projecting it with the Proxima [projector] for the class to see and read together. I couldn't get the Proxima to work...I wheeled it down...to my associate's room...I saw frustration on her face as she tried to figure out how to use a computer program....It then dawned on me that the best resource we have in teaching is our fellow teachers. I helped my peer figure out her program and she came to my classroom and helped me teach my lesson that had failed. At the end of the lesson, one of my students summed it up for me by saying, "It's always more fun with someone to help you." That is what I feel the US West TEEM project is all about...teachers helping each other. [Jane, teacher participant journal]

It seemed appropriate then, that when a group of participants met to begin CD-ROM design, graphic continua were used to determine progress of design, content and programming tasks. These strategies are currently being tested in other technology innovation professional development projects.

Progress: Extensions of the Project

The project was completed formally on June 30, 1997, but activity in this area continues. Several teacher teams planned a series of on going workshops in their schools for the 1997-98 school year to continue what they started in spring 1997 workshops. An elementary team submitted a proposal and received funding for a telecommunication curriculum grant project between their urban school and a Reservation school. The grant provides computers for two teachers at each school site, on-line and telephone technical support, and virtual training seminars. The principal at the urban school has indicated that through their participation in the TEEM projects, she has seen the benefits of using technology to support instruction and is willing to pledge any financial support needed to make the extended project successful.

The CD was introduced into CEE education courses Fall 1997, ensuring that the project continues at a different level. Developing a CD for inservice use and as a reference has provided inservice teachers with a tool for both introduction to and refinement of integration of technology into K-12 curriculum. We are confident that what was begun in this project will continue with the core teachers taking a leadership role in their school.

Teachers in the project directly or indirectly affected more than 125 teachers and over 3,000 students in the integration of multimedia and telecommunications during the two-year project. But possibly more importantly, the teachers in the project went through a two-year journey of finding what it is like to be learners in a constructivist learning environment.

My perceptions of a teacher-led process...has gone through several stages of transformation, kind of like an insect going through the stages of metamorphosis. When we started I wanted...wee little assignments and [a facilitator] to tell us exactly what we should be doing. Instead we were treated as professionals and given the license to do what we were best at doing....At first, this process was frustrating to me, I wasn't sure where my place was in this process. However...the group seemed to have fallen into step and we were off and running....I felt like we became an interactive team, pulling in the same direction to reach our goal—the CD-ROM. I don't remember anyone saying to me, you do this! ...Allowing this to be a teacher-led process was scary at first, however...it feels gratifying and empowering. This is an experience [constructivist environment] I want to bring into my classroom for my students. [Denise, teacher participant journal]

The teachers themselves were encouraged to provide direction for the project content and the final product. Each workshop was planned around teacher concerns and supported their evolving "control" over the project. This journey was long and arduous, but through reflection (journals, evaluations and surveys, focus groups, small and whole group conversations) most teachers left the project with a new or renewed sense of the effect of creating active and constructivist learning environments for and by the learner. Teacher comments indicate that their K-12 classrooms will never be the same.

Institutional Systemic Change

The Center for Excellence in Education has encouraged systemic change through various ways, with this project serving as one example. K-12 school and university partnerships in technology have centered around long-term instruction and support to teachers in the field. This includes working with inservice teachers both in state-of-the-art technology classrooms on campus and in the real-world classrooms found in K-12 schools. We feel this provides support to teachers on what can be done with what is available, but also what is possible. The networks of people created from this project and similar telecommunications projects have proved invaluable in continuing a project beyond its funding cycle. For example, three teachers involved in this project (two local, the other on the Navajo reservation) had participated in previous telecommunica-

tions projects sponsored by CEE and had already begun their own network for collaboration on curriculum. During the project, boundaries between participating school teams blurred as a teacher in a reservation high school collaborated with an elementary class hundreds of miles away on a telecommunications project unrelated to the TEEM project. Since then, several middle school and elementary teams have also formed collaborative groups that are in place today. We are looking towards simultaneous change; this project exemplifies the combination of preservice and inservice support for technology integration to make systemic change.

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Appendices

All of the appendices listed in this paper can be found on the SITE 98 CD-ROM version of the 1998 Annual.

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PROTOTYPES: TEACHERS' AIDES FOR COMPUTER INTEGRATION INTO THE CURRICULUM

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One of the most difficult transitions to using technology within the curriculum is the question of how to use it to help students meet the curricular requirements. Early software left a lot to be desired (Hasselbring, 1986; Hunter, 1989; & Jonassen, 1990). Teachers tried some of the programs and found that many did not live up to expectations. Many teachers felt technology in education fell short of the claims. Partly due to these experiences, integration of the technology has been slow in coming.

In addition, some teachers view the computer as an additional area to cover, rather than a means to further the curricular requirements (Smith-Gratto and Blackburn, 1997). Handley and Sheingold (1993) suggest that teachers need to use the technology to meet curricular objectives rather than as a separate content area. We agree that the technology is best used to further the curriculum and suggest that in addition to the development and use models recommended by Ehley (1992), templates or prototypes be developed to provide examples for teachers. Prototypes are commonly used in education. We are all familiar with the books that can be purchased in teacher supply stores which provide a variety of activities based upon a particular content or theme. These books contain a variety of activities and ways to use different types of educational aides which teachers use directly as written or adjusted for their curriculum objectives and students. It would simplify computer integration if examples of computer activities were combined with other classroom activities for teachers to use in the same way as the activity books.

The example of the type of prototypes needed will use the software, "Oregon Trail," since it is available in a large number of schools. We used the *Guildford County Schools Curriculum Guide* (1996) to provide a full example which incorporates content integration. Many of the activities address more than one area at a time. For convenience, the objectives are numbered so that it is clear which activities address each objective.

Objective s Addressed through Activities

(all are taken from the *Guildford County Schools Curriculum Guide*, 1996)

Language Arts

1. "Use print and electronic resource materials such as dictionaries, encyclopedias, and atlases." (p. 17)
2. "Revise by refining beginning and ending paragraphs." (p. 17)
3. "Write literary, informational, and practical texts to convey meaning, to learn, and to clarify thinking." (P. 17)
4. "Write descriptions that have a coherent, logical, and organized structure." (p. 17)
5. "Edit for errors in sentence formation - fragments and run-ons." (p.17)
6. "Edit for errors in usage - subject/verb agreement, pronoun case, double negatives, and use of apostrophies." (p. 17)
7. "Edit for patterns of mispellings." (p. 17)

Mathematics

8. "Explain the kinds of decisions that need to be made in constructing graphs."(p.18)
9. "Systematically collect, organize, appropriately display and intepret data both orally and in writing using information form many content areas." (p.18)
10. "Explore increasingly complex displays of data including multiple sets of data on the same graph, computer applications, and Venn Diagrams. (p.18)
11. "Compute averages within a context, using a calculator if appropriate." (p.18)

Science

12. "Explain and illustrate layers of the earth." (P.19)
13. "Explain natural processes that change the earth such as volcanoes, earthquakes, and weathering. (p.19)
14. "Compare and contrast weather and climate emphasizing concepts such as temperature, atmospheric pressure, clouds and land features." (p. 19).

Social Studies

15. "Describe the absolute and relative location of major land forms, bodies of water, and natural resources in the United States, Canada, and Latin America. (p.19)

Activities

1. Discuss the program "Oregon Trail" with students. Many will have already used the program and will be able to describe the things that happen during the simulation. Have students discuss the choices they will have to make (choosing supplies within a budget, trading, hunting, crossing rivers, amount of food to eat, and travel speed).
2. Explain that students will be using the information they collect for other activities. Put students in groups of two to complete the program. One student should act as a recorder, while the other inputs his or her responses to the simulation into the computer. Students can take turns being the recorder. Students should record the following information while they work on the program.
   A. Enter the date you begin your journey and end your journey and whether you reached Oregon.
   B. Enter the speed at which you plan to travel and each time you change your speed and the distance traveled each day.
   C. Enter the major landmarks, including rivers that you pass on your way.
   D. Enter the type of weather experienced each day of travel.
3. After completing the simulations, some time should be devoted to discussing what the students experienced during the use of the program. This discussion can then lead into the differences in the dates groups chose to start, when they finished, and whether they reached Oregon. Next, the teacher should ask the students how they can pictorially represent data. The students should be guided towards the production of graphs to represent the data. In their teams, have students write what information is needed to construct a graph showing start dates and with successful completion of the journey and a graph showing start dates which ended in unsuccessful trips. Once students make a list of needed information, the information will be put on the chalkboard. Each group is provided with graph paper and makes a line graph with the information, which has one color for the completed journeys and dates and another color for the dates the incomplete journeys were made. The teacher should then ask questions such as: "Are there dates that show a higher success rate than others?" and "Are there dates which indicate that the trip is likely to fail?" Depending on the data collected, the teacher should construct other questions which probe the students' understanding of the graphs. Using a word processing program, students can then be asked to write a short essay about what date they would choose to leave and why, based on the information in the graphs. The draft essays are then printed out, and students are placed in groups of four for editing. Once the editing is completed, students return to the word processing program and enter the changes. (Objectives: 2, 3, 5, 6, 7, 8, 9, and 10)
4. As a follow-up activity to Activity 3, students would plan and create a graph using the speed and mileage recorded during use of the simulation. Students would use a spreadsheet with graphing capabilities and a word processing program. As they plan how to use the data, students should be told to take notes, stating how they are using the data and why the data is being used in that manner. After making the notes, students would then create a spreadsheet and a graph. At this time they would make notes on any problems encountered with the data and how they made adjustments and why. Students then print out the completed spreadsheet and graph. Once the spreadsheet and graphs are completed, students would write a description of their planning and any problems they encountered using the word processing program. The descriptions would then be printed out, and students would edit the descriptions, make corrections on the word processor, and print out the completed description. As a whole class activity, students could discuss their planning process, the problems they encountered, and how they handled the problems. Data about distances traveled by each group would be placed on the chalkboard. Students can be asked what the average speed for each group was. The averages can be computed by hand, calculator, or a spreadsheet program. If students have more time, additional activities could include distance and speed problems related to the route traveled using other types of transportation such as cars, trains, and jets to create other graphs. (Objectives: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11)
5. After instruction on how the earth's features are formed geologically, students are given a blank map of North America. On the first map students will enter the natural landmarks and rivers encountered during their journey. Students will use resources such as atlases and encyclopedias (both print and electronic) to obtain those locations. As they use the resources, students should be asked to enter any other natural landmarks they find in North America. The teacher should then put students in groups and assign each group a natural landmark

found in North America (the Rocky Mountains, Great Salt Lake, Grand Canyon, the Great Lakes, etc.). Using reference resources, students will prepare a Hyperstudio report on how each of these features were formed geologically. (Objectives: 1, 4, 12, 13, 15)

6. After discussions on how climate and weather are related, students would use the data about the weather encountered on the trip to create a graph which uses the dates and weather encountered on those dates. Next, students would use CD encyclopedias and the World Wide Web to research the climates and weather patterns encountered in the areas traveled through during the simulation. Students would compare their graph with the information gathered in their research and discuss how that may affect the results encountered in Activity 1. Students would then create a database with categories that students believe are important in determining climatic areas. Next, students would compare what categories they felt were important and why. After discussions, students would refine and change their databases and enter any new information. Once students have completed the database, the teacher would give students characteristics of areas which resemble some of the data that students collected and have students determine what climate the examples are. As an extension, students can research climate types not encountered and enter their characteristics. (8, 9, 10, 11, 14)

Conclusion

In this paper, we have given a brief example of a prototype that could be used by teachers to help guide their integration of computer use into the existing curriculum. While in complete prototypes, more detailed descriptions of the activities and alternative activities would be provided, it is hoped that the brief example given here indicates what the prototype can contribute to solving the problem of computer integration. As can be seen, the prototype incorporates an tangential software program ("Oregon Trail") and the use of application software to forward the objectives within the curriculum. Since teachers often use prototypes to add variety to their class activities, it is believed that they can be used to assist teachers in the movement toward integrating computer activities and the curriculum.

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Using the Internet to Integrate the Curriculum with Technology

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The Internet has the potential to be the catalyst for technology integration. It will infuse our lesson plans with technology through it's communicating, publishing, presenting and resource gathering tools. It naturally leads to the use of many of the technology tools our students need to be productive citizens of the 21st century. Full implementation of technology into our curriculum, through using the Internet, will also help us attain other instructional reforms as it transforms our classroom from a passive environment to a more student centered, engaged, purposeful learning environment. This paper will present suggestions for integrating the Internet with classroom instruction.

Listserv: Educators Rest Stop

The Internet and its resources can be daunting. I found it no different when I started working with it in 1992. I decided not to be overwhelmed by the mountains of information it offered, but to use it as a natural extension for my student's telecommunication activities. Instead of our projects taking place on closed bulletin boards, the whole world could now participate through the use of listservs. Because of my success in using on-line projects, I designed and maintain the *Educators Rest Stop* (http://www.forum.swarthmore.edu/~carol/rest_stop.html) to answer some of the questions other educators may have as they explore integration through collaborative on-line projects. The site offers tips for finding and becoming involved with Internet based projects, along with lists of successful projects.

Many projects can be found on the Internet through either e-mail or the World Wide Web. For e-mail based projects you must subscribe to the list. As the messages come in everyday to your mailbox, you will see exchanges being made to projects in progress and you will receive Calls for Collaboration. A Call for Collaboration is the way to announce a new project to the Internet community. A good Call for Collaboration will contain a summary, timeline, curriculum area, grade level, and registration information My listserv address (also found at http://www.forum.swarthmore.edu/~carol/listserv.html) contains a list of some of the listservs that I have used, along with instructions for subscribing. You will find them full with many interesting and diverse projects.

If you would like to know more about the listserv and the projects the list runs, visit its web site. The web site will usually give you a chronological listing of its most successful projects over the past year, along with information about each project. If you find a project that interests you and the information is from last year, don't despair. Write to the moderator concerning the project's status. Most projects are run annually. Take a minute to browse my web site (found at http://www.forum.swarthmore.edu/~carol/web.html) for additional information.

Where to Start: Websites

Internet based projects are a wonderful way to integrate technology into curriculum and to introduce students to the culture and diversity of the world through global dialogue. However, I have found that educators new to telecommunications and the Internet are very hesitant to get involved. Most educators new to the Internet are uncomfortable with the collaborative effort required from on-line projects since they are unsure of their Internet skills. They need time to polish their e-mail techniques - sending, receiving and replying to messages without the burden of handling the extra volume of mail associated with listserv membership and the constriction of a project timeline.

The easiest place to start for most educators is sharing a favorite lesson plan with the global community. Most of us have a favorite lesson plan that we hone each year, adding and subtracting ideas to make it better. Posting these lesson plans with supporting handouts and student work to the web is a very non-threatening place for educators to start. Because they're comfortable with the lesson and proud of the student outcomes, they're more than willing to share it with colleagues. With the help of WYSIWYG, page authoring programs such as PageMill and Claris Home Page, I have had success not only with teachers, but also with students as young as second grade becoming web publishers. Web Sites, which successfully use this model to present their methodology and pedagogy to the global

community along with student outcomes, are iincluded in the reference section.

WebQuest

Once educators test the waters of publishing on the web they are more than ready for the next step of designing lessons that incorporate the presenting and resource gathering tools of the Internet. Dodge (1997 gave a name to these integrated activities - WebQuest . A WebQuest presents the students with a task or problem to solve. It provides all the resources they will need to explore and solve the problem. Then it typically asks the students to synthesize their learning in a summarizing act such as a web page presentation, newspaper, e-mail exchange, or a power point presentation for their peers. It also defines in detail the process the students should follow to successfully accomplish the task, along with assessment criteria. The following full WebQuest designed by the faculty of Germantown Academy are a good example of how a variety of culminating activities can incorporate various technology tools:

* *Forensic WebQuest* http://www.ga.k12.pa.us/curtech/physiolo/forquest.htm
* *Mexican WebQuest* http://www.ga.k12.pa.us/curtech/modlang/spanish/sp3mexqu.htm
* *Spanish Cooperative Learning/Writing Project* http://www.ga.k12.pa.us/curtech/modlang/spanish/spaquest.htm
* *Marine Biology Animal Adaptation WebQuest* http://www.ga.k12.pa.us/academics/US/science/mbiowqst/index.htm/
* *Forum Romanum* http://www.ga.k12.pa.us/academics/MS/8th/romanhis/indexrom.htm

If you have only three to five class periods to complete an integrated task, a short-term WebQuest such as Sampler, Scrapbook or Treasure Hunt may be helpful. Faculty at Germantown Academy designed modified quest for a variety of disciplines:

* *Movies in Madrid* at http://www.ga.k12.pa.us/academics/MS/8th/Mersky/spanish/spmovie.htm is sample of Treasure Hunt where the students are asked to answer a variety of questions.
* *¡Hola! ¡Bienvenidos a la Florida*! at http://www.ga.k12.pa.us/academics/MS/7th/florida/florintr.htm is an example of a Scrapbook quest where students are asked to put together a page of scrapes on a specific topic.
* *Art Sites Search* at http://www.ga.k12.pa.us/academics/MS/7th/Osterwei/explain.htm is an example of a Sampler where students are asked to evaluate Art sites from a personal perspective.

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Second Grade Dinosaur Unit http://www.ga.k12.pa.us/academics/ls/2/2ndtitle.htm

Colonial Stamp Project, http://www.ga.k12.pa.us/academics/ls/4/sstudies/Colonial/SThomepg.htm

The Wonderful World of Tall Tales, http://www.ga.k12.pa.us/academics/ls/4/la/4r/talltale/introres.htm

Tankas about the Oregon Trail http://www.ga.k12.pa.us/academics/ls/4/la/4v/tankintr.htm

Fourth Grade- Independent Study Groups - A Constructivist Approach, http://www.ga.k12.pa.us/academics/ls/4/la/4v/indepstu/indepint.htm

A FIFTH Grade's Interdisciplinary Units on Native American Mythology, Civil Rights, and China
http://www.ga.k12.pa.us/academics/ls/5th/homepg5.htm

The Children's Spanish Storybook Project http://www.ga.k12.pa.us/academics/US/ModLang/Spanish/spanish4/introS4.htm

http://www.ga.k12.pa.us/curtech/WEBQPRE/quesintr.htm will give you a chance to look at various Internet integrated lessons, download a template to design your own lesson, give you sample Rubrics for student outcomes, and introduce you to the tools students will need to produce their culminating activity.

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Driver's Ed. For Teachers Navigating the Information Super Highway

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The teachers chosen to participate in the project depict the ability and desire for a paradigm shift in the way that they think about teaching, learning, and the role of technology in their schools. These distinguished teachers were awarded graduate assistant positions for two semesters and one summer at Northeast Louisiana University while on sabbatical leave from their respective schools. Course work taken during their assistantships includes not only specific Internet training and incorporating Internet technology into the classroom curriculum, but also instructions in methodology and leadership training. The goal of the project is to empower the teachers not only to navigate the Internet, but also to achieve the skills necessary to return to their school districts to enhance the quality of learning and teaching of their colleagues.

To evaluate the success of this program, the participants have been given a survey that includes both objective and open-ended questions. This paper will present a summary of the responses for the three identified groups.

Group I: The trained and practiced group. Teachers who have completed both a year of training and a year of implementation in the classroom.

Group II: The trained but no practice group. Teachers who have completed a year of training and have just returned to the classroom.

Group III: The group that has no training or practice. Teachers who have just begun the training phase.

Because Group III has just begun the program, there are limited responses to the open-ended questions from this group. At the time of the survey, Group II had yet to put the program to practice, but many have examined how they will incorporate technology into their curriculum during the new academic year, and these thoughts have been reflected in their open-ended responses. As a whole, an overwhelmingly positive attitude toward the program has been expressed by majority of the participants.

Introduction

The essence of the "Driver's Ed. for Teachers Navigating the Information Super Highway" is a plan to address the problem of training and retraining of classroom teachers (trainers) who will then train and retrain their colleagues and students to utilize the Internet in order to expand and enrich their educational experience. The project has been made feasible because the State of Louisiana established a statewide network, LANET, in December 1992. By December, 1993, provisions were made for all public and private colleges and universities in Louisiana to be connected to LANET and, consequently, to the Internet. The State instituted a master plan calling for all K12 schools to gain access to LANET starting in 1994. The missing link has been a comprehensive training program for educators that will stimulate the application of Internet resources in the classroom and the continued growth of teachers.

When it is completed in 1998, this three year project will have provided these school districts with a cadre of welltrained resource persons and the support necessary to benefit from electronic networking. This project will, in the space of three years, have prepared 60 teachers in fifteen school districts to successfully use Internet technology, effectively integrate resources on the Internet with state mandated curriculum guides, translate the technology into daily classroom activities, and train their colleagues. Personal networking and electronic communication channels will have been established so that these teachers will have continuing access to sources of expert assistance in their teaching endeavors at all times. Based on the survey responses, it can be concluded that the training that has been provided by this program has had an overall positive effect, thus benefiting the fifteen participating local school districts.

The survey was looking mainly at what impact, if any, technology is having on the participant and his or her

students as a direct result of being a part of the "Driver's Ed. for Teachers" Program. Open-ended questions were designed to investigate changes, if any, in teaching methodology and to what extent these changes were impacted by the implementation of State and National Standards for mathematics, science, and technology. Also targeted were changes in teaching style as a direct result of using computer activities and how these changes have affected classroom procedures. The results of the survey are also being used to help determine the direction that the "Driver's Ed. for Teachers" Program should take before resubmitting for a future program of this type. The survey collected information about the participants such as: teaching background, demographic information about school and school district, and professional enrichment and training activities. We feel that these issues have a direct impact on the participants and cannot be ignored when viewing the survey results.

A total of 27 participants responded to the survey. Replies from the survey reflect a sample from each of the three groups, with over half of the responses from Group because they were attending classes at the university when the survey was taken. Although the numbers were small for Group I and II, they reflect a 33.3% and 36.8% respectively, while Group III had a 66.7% of returned surveys from the participants for the three years program. Participants from all three groups represent a sample from each grade level.

The three groups were categorized by the level of their participation in the program, with Group III starting the program, while Group I and Group II having completed the intensive course work that included an on site practicum. This practicum was conducted in their parish as a computer technology liaison and Internet trainer. Through workshops, seminars and demonstrations, they provided faculty and staff the opportunities to examine and exchange viewpoints about the role of technology in education.

The first section of the survey asked the teachers questions about their teaching experience. Information on how many years of teaching experience, grade level of experience and subject matter that each had taught was summarized. In analyzing Question one, Group II and Group I teachers reflected averages of 18.7 and 20 years of classroom experience respectively. These numbers alone would lead one to think that both groups had equally experienced teachers. However, the minimum and maximum numbers for Group I were 14 years to 24 years, while Group II had nine years to 24 years. Group III displayed the least teaching experience with an average of 13 years of teaching experience with a minimum of seven years and a maximum of 18 years. This observation was interesting because it was the seasoned teacher who first became involved with a program that emphasized technology rather than the teacher with less classroom experience.

Responses to Question two illustrate the grade level for teaching experience of the participants. The results show that the background of Group I participants represented school types of K-12, elementary, and middle schools; Group II represented a sample from each of the school types of the survey; and Group III dominated elementary, middle school and high school levels. This indicates that on completion of the three-year program there will be a base of experience and expertise available for each grade level of K-12 on the utilization of the Internet for the participating districts.

The results from Questions four and five demonstrate that the participants represent every grade level of school and a wide area of subject matter that is being enhanced by the participation of the teacher. As stated in the introduction, the thrust of this project was to train K-12 teachers in the utilization of Internet with emphasis on integrating its resources in teaching methodology across the curriculum by using the State and National Standards for mathematics and science as a model.

State and National Standards for mathematics, science and technology stress that instructional materials and equipment can increase students' interest and improve achievement. Students should have access to materials and equipment and be offered opportunities to learn to use them effectively. It is essential that classroom teachers have the necessary non-consumable and consumable material and equipment and that they have means to maintain and/or replenish these as needed. With this in mind, the survey directed Questions five through nineteen to investigate the school and school district profile of each participant.

In accessing these responses, we found that there is a critical need for more classrooms that are equipped with computers and Internet connections. For reform to occur in the classroom, it is imperative that hands-on teaching is included in the curriculum. It is recommended by the National Council of Teachers of Mathematics and Science that classrooms should keep current with the state-of-the-art technology appropriate for the grade level being taught.

The results of our survey show that schools and school districts have projected an increase in their spending for technology for the 1997-98 school year. We feel certain that this is a direct impact of the new technology plan that was implemented this year at the state level. Millions of dollars were earmarked to enhance technology at the K-12 grade level by the state legislators. In personal interviews of several of the participants of this program, many have played key roles in authoring and researching information for their parish technology plans that were submitted this past July to compete for these funds. Group I and Group II have also had several of their participants taking on new jobs as technology coordinator for their districts.

Professional enrichment and training are the thrust of the program to prepare the participants to return to their school

and district as a trainer of Internet for others. This program has provided opportunity and encouragement for the participants to attend state and national meetings in their disciplines and to become involved with the technology plans in their own districts. It has opened the door of opportunity to many as they have returned to their districts as the technology coordinator and Internet trainer. For some, these skills take them beyond the schools and into the community through training for local businesses, organizations, and churches. This effort has help build an infrastructure and technical support for not only education facilities but the entire community.

State and National Standards require the integration of technology into the curriculum. The participants were asked: to what extent have State and National Standards for mathematics, science, and technology affected the participants teaching of the curriculum? Having been exposed to these standards, many of the Group I teachers have stated that changes have been made in the classroom to reflect those standards. Following the lead of the national standards, new benchmarks have been mandated by the state. At least one of the local parishes has also developed a technology plan and is presenting it to the state for approval. Another teacher commented: "My curriculum was affected drastically in that I teach math only. The Standards are very well planned and it is easy to find Internet access to sites that are in conjunction [with the standards]." Group II teachers anticipate that they will be using more discovery techniques with more observationtype (as opposed to test) evaluation. As a result of the State and National Standards, the instructional methods of Group I and II teachers will be geared more to application rather than rote memorization.

What part of teaching with computers is viewed by the teachers as the most difficult? Responding to this question, numerous comments have been made. A great deal of planning and organizing has to be done in order to use computers in the classroom. This was the consensus of Groups I and II. Accommodating students who do not have many computer skills and are not secure in the new environment is of major concern of one of the Group I members. In other words, each student must be brought to a common point of understanding. Most are either very knowledgeable or have no experience at all. Another issue of difficulty that the participants have addressed is the shortage of computers for effective instruction and the money needed to upgrade and connect to the Internet. Members of Group II foresee many of the same difficulties. They also have noted the need to plan for failed access to the Internet. One respondent has revealed that backup activities might be needed, or activities should be planned that can be done while waiting for the downloading of links during heavy use times. While there are difficulties with the utilization of computers in the classroom, being aware of the challenges allows these teachers to prepare for them.

Participants were asked to describe how the program has been beneficial to their professional development. Groups I and II, have conveyed that the program has been very beneficial to their professional development. The teachers of both groups have acquired expertise in the area of incorporating the Internet into the curriculum. These participants are now able to train others, and they themselves have grown professionally and simultaneously have received "beneficial exposure." Additionally through this program, some Group I and Group II teachers have been able to attend NECC and LACUE conferences, work towards masters plus 30, and attain certification in Computer Science and Computer Literacy. Another Group I teacher notes that this program has delivered a new excitement about teaching. It has been expressed by a Group I participant that these teachers have been provided with an opportunity and the time to explore a medium that, at the beginning of the program, they knew nothing about. Group II members note that at this point they have become more aware of changes in technology and how to integrate it into instruction. They have revealed that they are excited that, through the workshops they have taught, these teachers have been able to transfer their new found knowledge and excitement to other teachers in their own school systems. It can easily be concluded from these enthusiastic responses that the "Driver's Ed. for Teachers Navigating the Information Super Highway" program has indeed been beneficial to these teachers' professional development in a multitude of ways.

The participants were also asked: Overall how was your participation in the program beneficial to your students? "Whenever a teacher is excited about something new, the children know it and when that knowledge is shared, they grow! My students have blossomed! They enjoy the computer, the Internet, and they enjoy being successful! If children do not learn the way we teach them, we must change and teach them the way they learn. Computers enable us to do that and so does this program!" replied a Group I teacher. Furthermore, another Group I participant responded that students are learning skills which will help them get a job. Additionally, a Group II member observed that when students are "playing" on the computer, more retention has been observed and interest is increased. Taking these responses into consideration, it can be concluded that while the program has been beneficial to the professional development of the participants, it has also positively impacted the current and future students of these teachers.

Is the "Driver's Ed. for Teachers Navigating the Information Super Highway" program also beneficial to the teachers' home schools? In response to this question, a Group I educator notes: "I gained training expertise. I am able to go out and train others, and I am able to use the knowledge I have gained to grow professionally, and also secure grants for the school." Teachers are now trained and

can provide staff development training in Basic Computer Terminology and the Internet. It has been reported that a Group I teacher's home school was even been selected as a pilot school for their Parish Technology project in Spring of 1997 and that many of the participants have been able to have their schools connected to the Internet. Group II participants have also had similar experiences. Teachers have also aided their schools in writing technology plans. Based on the responses, it can be concluded that the home schools of the participants do indeed benefit from the "Driver's Ed. for Teachers" Internet program as well.

The respondents were then asked: "Overall how was your participation in the program beneficial to your school district?" When examining the program's benefits to the school districts, responses have revealed that these educators have been able to extensively train other teachers in the school systems with Internet as well as receiving training themselves. Others feel it has helped move their schools forward. It has also been noted that among teachers, a positive attitude is growing toward technology. One respondent states "Hopefully my participation and the other teachers' participation will inspire funding and commitment to technology." Group II respondents also have made very positive statements. One teacher has announced, "I have had great support. My district is willing to try all forms of technology. We are striving to put a computer in every classroom. We did a tremendous amount of training all summer." These teachers will now be able to help their districts meet their goal of producing productive, technologically literate citizens. Participants of the "Driver's Ed. for Teachers Navigating the Information Super Highway" program have indicated that they have even helped to write the parish technology plans which will aid in receiving technology funding from the state. Participating school districts will therefore become more competitive in the "technology race" because of the "Driver's Ed. For Teachers" Internet program and will better prepare their students for future career success.

Enthusiastic responses abounded when teachers were asked: What do you most enjoy about teaching using computer activities? "Everything! It is magic in the classroom. The kids love it!" responded a Group I educator. Others have noted that it is motivating for the students and, as a result, the instructor. It offers versatility and peaks students interests. Respondents from Group II foresee that having up to the minute information available will be an asset. Evaluating these responses, it is apparent that the utilization of computer activities in the classroom have increased the teachers' enjoyment of teaching.

Let us look at the focus of this paper: Is the "Driver's Ed. for Teachers Navigating the Information Super Highway" program meeting its goal? Reviewing the responses of the participants of Group I, while it is preliminary, it is apparent that the program is achieving its goal thus far and will continue to do so for the remaining two groups. Attitudes towards the program are very positive and the results are beneficial on not only the personal but the student, school and district levels as well. The visions that Group II express reveal their enthusiasm towards technology in the classroom. It is this enthusiasm that radiates and thus creates desires within others in their school systems to pursue the benefits of technology. Based on the plethora of benefits cited by the participants of Groups I and II, it can be assumed that Group III will, after receiving training and implementing this training, express similar positive attitudes and benefits of the "Driver's Ed. for Teachers Navigating the Information Super Highway" program.

Providing Teacher Inservice Technology Training K-12

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Kwajalein Schools, located on the island of Kwajalein in the Republic of the Marshall Islands, is a private school system organized on the American school model, and it is NCA accredited. Located 2300 miles southwest of Hawaii, the schools serve 465 students in grades K - 12. The students include dependents of US Army personnel and government contract employees stationed on Kwajalein as well as approximately 85 Marshallese students. The school employs 47 faculty and staff who teach on two campuses.

Preceding Events

New hardware received in the Kwajalein Schools during the '96-97 school year included 120 new Pentium computers with at least 16MB RAM and a 1GB hard drive, 17" inch monitors, a 21" monitor for each building, 42 HP DeskJet 870cxi color printers and 6 HP laser printers.

Half the computers were installed in 4 labs. A computer and color printer were placed in each classroom, and the remainder were located in two libraries and school offices. During the summer of 1997, 10 TV Converters also arrived.

Software on each computer included Windows 95, MSOffice 95 and a grading program site license which many teachers were already using. Other software was available, but many programs were not compatible with the new hardware.

Problem

Our problem was to provide a productive inservice at the beginning of the 97-98 school year which would enable the staff to utilize the new computer equipment and compatible software. Five inservice days were scheduled in August for training of faculty and staff as well as classroom preparation. The staff had various levels of expertise. One teacher had used the Internet and Journey North in her 6th grade classroom during the 96-97 school year, while another had not even turned on the machine.

The location of the school is not conducive to bringing in outside instructors. We have done this in the past, but many ideas and applications have not been effective in our isolated location. Distance from the mainland, unreliable international phone service, time zone and date line differences all make communication with prospective workshop leaders difficult.

Solution

In May of 1997, the staff was surveyed for interest in either a beginner computer class or sessions specific to MSOffice 95. Based on the survey, a two day session was offered for beginner computer users to familiarize them with Windows 95 and Microsoft Word. Others requested specific MSOffice sessions in Excel, Word and Power Point or use of additional available software and technology hardware.

Beginner Class

For those interested in a beginner computer class, a one semester hour of credit was offered through the University of Maryland. I was the instructor and familiar with the levels of those enrolled.

Course Description. This course was designed for teachers with little or no experience with a microcomputer. The course was specific to Windows 95, a limited use of Microsoft Word 7.0, and software which was available at the time on classroom machines.

Prerequisite. None

Course Objectives.

Be aware of rapid and relevant changes in technology.

Be familiar with hardware requirements and specifications of classroom computers.

Be able to use Windows 95 and maneuver around in My Computer.

Be able to create a document in Word and save to the hard or floppy drive.

Be familiar with care and use of floppy and CD-ROM disks.

Be able to use the printer attached to their classroom machine.

Become comfortable and less intimidated using the computer.

Grading. Grading was based on active participation. After the initial instruction, participants had time to use the machines in their classrooms. The course used a pass/fail grading system.

Fifteen teachers chose to take the beginning course. Eleven enrolled for one semester hour of credit. Of the fifteen, twelve had worked with Windows 3.11 or had some exposure to Windows 95. Those remaining had little to no experience on a computer. The class met in the elementary computer lab on the second and third day after school began.

Day One, Morning Session. The entire time was spent working with Windows 95. I wrote my own handouts beginning with a list of computer terms and their meanings. Other handouts included Turning On the Computer and Starting to Work on the Desktop, Working With My Computer, and Switching Applications. The handouts were used in a Power Point presentation. Participants read through the handouts as I demonstrated to them what was to be done on the computer. Then, they chose a computer in the lab and completed the handout on their own. Participants assisted each other as they encountered problems working through the handouts. I was available to assist those who were having additional difficulty.

Day One, Afternoon Session. I introduced word processing beginning with WordPad. I have found that WordPad is simpler than Word 7.0 and does not have as many confusing icons, toolbars and key combinations. Participants were taught how to create a document and keyed in a letter concerning a job opening. They carefully checked for misspelled words—as there is no spell check in WordPad—and printed a hard copy. I then gave them a copy of the same letter to which I had made changes. They were to make their document look like my example. Participants learned to center, bold, underline, bullet, insert and delete selected text, change text color, font and size, and print a color copy of the edited letter. By the end of this session, they were ready to move to Word 7.0.

Day Two, Morning Session. Class began with formatting a floppy disk, creating folders on the floppy, keying in four short documents using Word 7.0 and saving these to their floppy disk. I demonstrated how to change margins in Page Setup and also within a document. Participants were now ready to try a document on their own. The remainder of the morning was spent keying in, saving and printing beginning-of-the-year letters to parents, class rules, schedules or whatever each teacher would need to start their first week of school. Participants were excited using the computer and commented that the computer was actually helping them with beginning-of-the-year tasks.

Day Two, Afternoon Session. Participants learned how to make a decorative frame on an 8.5" x 11" sheet of paper and insert a text block. They were now ready to put their saved class rules, class list, or favorite poem into a frame, save it to disk, and print color copies to be used in their classrooms on the first day of school. The remainder of the afternoon was used to apply the knowledge they had acquired for creating, saving and printing documents for specific use in their classrooms. Participants left feeling the two days spent on inservice had been valuable and had helped them with beginning of the year preparations.

Other Offerings

On Kwajalein, Information Management Division (IMD) provides hardware and software support for the computers on island. In June, I contacted IMD and asked for assistance in providing sessions specific to MSOffice. With IMD's aid, five half-day sessions were made available: 1) Creating Presentations Using Power Point, 2) Using the Data Base Features of Microsoft Excel, 3) Creating and Editing Tables in Microsoft Word, 4) Envelopes, Mail Merge and Form Letters in Microsoft Word, and 5) Integrating Technology Into the Classroom. This last session demonstrated use of the TV Converter, laser disc player, LCD panel, digital camera, and software programs available. An IMD trainer taught the first 4 sessions at IMD's computer lab. I led session 5 as I was familiar with the additional hardware and software available to the schools.

Staff members were required to attend at least two sessions, but were permitted to attend as many as they desired. The remainder of the inservice time was devoted to organizational building meetings and classroom preparation.

Results

The response to the inservice has been overwhelmingly positive. The entire staff learned new and/or different skills during the inservice. Teachers said this was the best inservice we had ever had. Faculty and staff began the school year excited about using their classroom computers and technology. They no longer feared the hardware or software. Teachers have continued to use ideas presented in their sessions and share results with each other. They have requested that similar sessions be offered for our spring 98 inservice.

Since the inservice, I have offered after- or before-school mini-sessions, lasting less than one hour, on additional MSOffice tips, shortcut key combinations in Word, understanding and using the network and the Internet. Many teachers have access to the Internet at home so I have made handouts available. One addressed URLs, which they could access to give them practice surfing the Internet. Another explained different search engines and how to use each. Individual classroom teachers are also sharing their expertise in using specific software. Examples of such sharing include an after-school session on using Microsoft Bookshelf for teachers of grades 4-6, presented by a teacher comfortable using the software. Another session demonstrated the use of a word processing program which incorporates graphics to create reports or stories. Each first, second, and third grade classroom has its own CD-ROM to use with this software program and a knowledgeable third grade teacher presented this after-school session.

Conclusion

As teachers, we face the challenge of continued rapid change in technology. How do we stay abreast of all that is happening? One person cannot do it. It needs to be an educational team effort. Inservice can build a solid foundation of training, and also pull the team together. We must then continue to help and support each other. At Kwajalein, we have had a great beginning. We know our task is not complete, since new and additional hardware and software will continue to become available and be installed. We will continue to provide staff inservice and support to each other in the field of ever-changing technology.

Building Bridges: Technology and Curriculum Theory and Practice

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Throughout the 1980's and 1990's a number of factors have led to the creation of formal undergraduate and graduate experiences in technology and education for preservice and inservice teachers, so that they may better serve K - 12 students. Such factors include: various reports critical of current practice in education and offering ideas for reform (Gardner, 1983); research on computer competence nationally (Martinez & Mead, 1988); technology as seen as a means of school restructuring (Bruder, 1992; O'Brien, 1991; Papert, 1980; Papert, 1993); and a growing concern that students need facility with technology as preparation for further education and for the world of work (Marshall & Banon; 1988, Naron & Estes, 1986; Gilder, 1993). One such response (Brownell, Haney & Sternberg, 1997) is a 33 semester-hour Master of Education in Classroom Technology program at Bowling Green State University which was designed with careful attention toward national guidelines in computer education for teachers as developed by the International Society for Technology in Education and adopted by the National Council for Accreditation of Teacher Education (ISTE, 1992; NCATE, 1992, Thomas, 1993).

This brief paper will present a snapshot of information about a six semester-hour experience taken by students during their second summer of coursework, as hours 13 through 18 in their program (EDCI 611 - The Curriculum, and EDCI 635 - Technology, Problem Solving and the Curriculum). The courses were taught back to back (with a lunch break between) for 3 hours and 10 minutes each and met twice a week for six weeks.

Importance of Curriculum Studies and Developing Problem Solving Skills

It is vitally important that educators understand the field of curriculum studies (Tanner & Tanner, 1995; Eisner, 1994). Topics such as curriculum design, development, implementation and evaluation; philosophical and psychological bases of curriculum; societal influences on curriculum decisions; history of curriculum; and instructional methodology as it relates to the curriculum are standard in a course such as EDCI 611. For teachers and administrators interested in technology and education, this understanding of curriculum becomes even more important because of the many ways technology may influence almost all of these topics. It is further important because technology adoption and integration may either be driven by informed educational decisions made with regard to curriculum and instructional practice, or technology adoption may drive educational choices made on the basis of technology availability without regard to educational (pedagogical) considerations. It is our position that informed educational decisions should drive technology adoption—that technology should be used in service to education. We do not believe that technology should dictate the form education should take, simply because the technology exists. Indeed, few educators would adopt the latter position.

Course Descriptions, Texts, Goals and Assignments

Below, we present the description, required text(s), goals and assignments for each course. Please note that the final project, at the end of this section, was completed to fulfill requirements for both courses, in an attempt to bridge the content of both courses in a practical way. Also, please note the second required text in EDCI 611 (The Connected Family, Papert, 1996). This allowed us to address many relevant curriculum and technology issues from the viewpoint of societal (family) involvement and with an emphasis on technology and technological fluency.

EDCI 611

Description: EDCI 611 - The Curriculum (3) - Sources of curriculum: foundational bases for contemporary curriculum; forces that shape design and development of curriculum; and factors relating to implementing, modifying, and evaluating curriculum.

Texts used in the course:

- Elliot W. Eisner, Elliot, W. (1994). The educational imagination: on the design and evaluation of school programs, Third Edition. New York, New York: Macmillan College Publishing.

- Papert, Seymour. (1996). The connected family: Bridging the digital generation gap. Marietta, Georgia: Longstreet Press, Inc.
- Chapter 8 - Learning, from: Dertouzos, Michael. (1997). What will be: How the new world of information will change your lives. Marietta, Georgia: Longstreet Press, Inc.

Goals - each student will:

- Understand the components of the field of curriculum studies and the components of curriculum development.
- Understand influences (both historical and contemporary) that affect the development of the curriculum and affect the development of instructional practice.
- Identify ways the components of the field of curriculum studies and curriculum development affect teachers and students daily activities;
- Understand ways various implementations of technology may affect the curriculum and instructional practices.
- Investigate resources available for curriculum studies, and curriculum development, implementation and evaluation.
- Investigate and understand the role technology plays in the culture, the family unit and in schooling and education, with regard to the curriculum and instructional practice.
- Understand the concept of Media Literacy and identify and discuss one or more examples of video-based objects of study for a Media Literacy curriculum.
- Identify a specific curriculum or portion of a curriculum, analyze it's underlying theoretical principles, and introduce the use of technology into the curriculum using either constructivist or behaviorist principles.
- Identify possible changes in the learning environment over the next two decades due to advances in technology.
- Understand the current problem-based learning activities that are part of SchoolNet, and what they might mean regarding curriculum and instructional practice in Ohio.

Assignments for the EDCI 611 course:

- Round Table listserv—participation by each student in an ongoing discussion of topics from both courses.
- Group (formal) presentation to class of assigned chapter in Eisner
- Group (formal) presentation to class of assigned chapter in Papert
- Group curriculum studies/curriculum development resources investigation and informal presentation
- Group investigation, discussion, and informal presentation of assigned web site/CD resource
- Media Literacy (individual) - taping/in-class discussion & informal presentation
- Final Project

EDCI 635

Description: EDCI 635 - Technology, Problem Solving and the Curriculum (3) - Investigation of technology as a means to teach problem solving in the curriculum. Coverage of Logo and extensions of Logo, as well as other software to develop problem solving skills. Emphasis on a constructivist approach to using technology to develop students' problem solving abilities. Prerequisite: EDCI 633 - Hypermedia for Educators I.

Text used in the course: Jonassen, D. H. (1996). Computers in the classroom: Mindtools for critical thinking. Englewood Cliffs, NJ.: Prentice-Hall.

Multiple additional readings were assigned in class.

Goals - each student will:

- Learn fundamental problem solving skills in relation to structured programming and structured design.
- Apply top-down design skills by successfully writing programs utilizing superprocedures, procedures, and subprocedures.
- Learn a subset of Logo commands related to the turtle graphics environment.
- Learn a subset of Logo commands and techniques for handling list processing in Logo.
- Investigate the use of Logo as computational geometry and understand what curriculum implications that entails.
- Become acquainted with and able to use various extensions of Logo.
- Explore and use a variety of software packages designed to teach problem solving in the schools.
- Read about, understand, analyze and critique various models and theories for teaching problem solving in the schools, especially in relation to using classroom technology.
- Cite, analyze and discuss different forms of assessment regarding the learning of problem solving.
- Understand the current state of research regarding teaching of problem solving in the classroom, especially as this relates to the use of classroom technology.
- Demonstrate the ability to design learning experiences that use technology to teach problem solving and the ability to integrate those experiences into the curriculum.
- Compare and contrast a constructivist versus a behaviorist approach to the learning of problem solving in the schools, especially as this relates to the use of classroom technology.
- Become familiar with various methods for teaching problem solving in the classroom especially with relation to the use of classroom technology.

Assignments for the EDCI 635 course:

- Round Table listserv (same project as EDCI 611).
- Logo Exercises.
- Software Evaluation—Written evaluation of one or more problem-solving programs, submitted for inclusion on class web pages.

- Annotated Bibliography—summary and critique of 10 reputable resources related to the final project and problem solving, problem-solving strategy, or problem-solving theory.
- Readings—For each text chapter and article read, students submitted in writing at least one question and one reflection for discussion purposes.
- Presentations—a summary and demonstration of what was learned from the bibliography readings: a demonstration of an evaluated program and description of how it could be used in the classroom.
- Final project.

Final Project: EDCI 611/EDCI 635

The final project is a major project through which students demonstrate and apply knowledge, skills, and concepts learned in both courses. It involves the integration of problem solving and technology into the curriculum. Students submit proposals for projects that demonstrate and make practical use of what they have learned, complete the projects, and present them to the class.

Options given for projects include:

- writing a unit involving use of technology for problem solving;
- creating, for use by students or teachers, a program, hypermedia product, or MicroWorlds product that involves problem solving ;
- developing a problem-solving curriculum for your school, grade level, or class, that includes the use of technology;
- modifying the existing curriculum, including addition of problem solving and problem solving with technology;
- any instructor approved project that meets the students needs and the course requirements.

Within the project written justifications are included for choices made in the project. The justifications should relate to both problem solving concepts and curriculum studies and development and should demonstrate student understanding of information and concepts covered in both courses.

In terms of curriculum, the justifications should address the following questions:

- What influences are manifest in what you did?
- What curriculum ideologies?
- What are implications in terms of implicit, explicit, and null curricula?
- What type of evaluation/assessment is present or implied?
- How do you categorize the use of technology in relation to Papert's views?
- What are implications in terms of instructional practice?
- What are implications for implementation?
- What are implications for faculty education/training?

In addition, the justifications should address the following questions with regard to choices made about problem solving:

- What types/heuristics/strategies of problem solving are involved and why did you choose those over others?
- What benefits/results/transfer/outcomes can be expected with relation to problem solving and thinking skills?
- What assessment strategies/issues related to problem solving are involved?
- What purpose does technology use (related to problem solving) serve and how does it impact the project?
- What practical issues (related to problem solving aspects of the project) need to be addressed during implementation?

Reflection and Future Directions: We're All in This Together

Overall, the experience was a success. Several areas we will revise in the future include the coverage of Logo in the EDCI 635 course. There may be better ways in EDCI 635 to present the ideas about problem solving we are currently covering through Logo. Also, coverage of Logo itself may be better suited to a different course in the program. The listserv provided a lively forum for outside-of-class discussion on the topics in the courses, as well as fuel for in-class discussions. The final project was a great success, as students made major contributions to their schools and districts and used the vocabulary and concepts developed in both courses to express and defend the choices they made. Projects ranged from inservice professional development for whole districts to insightful integration of technology in many different (existing) curriculum areas to the development of new curriculum in conjunction with a statewide technology integration project.

As with any "first-time-through" experience there are areas, both on the problem-solving and the curriculum sides, that we will deepen prior to the next offering. Resources are always a problem, and we were fortunate to start with a good base of software, but by next summer we will be able to increase availability of problem solving software for review and classroom use. In the curriculum course, we will introduce better coverage of the "reconceptualization" of the curriculum field and how that relates to the life of the teacher. As Pinar (1995) points out, many courses such as EDCI 611 are still taught on a curriculum development model that has been replaced (or at least challenged) by a curriculum understanding model due to the reconceptualization of the field that began in the 1970's.

One main concern of this endeavor was how to make course topics relevant. Teachers sometimes view topics from the curriculum course, in particular, as impractical in regard to their daily activity. This is not a unique problem, but one that needed to be proactively addressed by both the nature of the work in the courses and as a topic of discus-

sion within each course. With our approach, we strove to establish lasting, meaningful relationships with course participants, and actively engaged participants in discussions regarding the scope of the course, value of the content, place of the course in their program, etc. As one student positively observed, "We feel like we're all in this together." Given this basis for facilitation, it was possible to explore relevant topics against a backdrop of practical use and develop ideas and views that teachers rarely have time to explore, given the current structure of schools. In this way, each participant (graduate student and instructor alike) was seen as having something unique to bring to the learning experience, and that uniqueness was highly valued, shared and developed.

Conclusion

As technology integration in the schools proceeds there are many areas of opportunity for teacher educators with an interest and background in technology to explore that, we believe, can further aid the process of that integration. As educators interested in technology, we all have a story to tell. It is obvious that those stories can be told from the perspective of technology. It is not as obvious that we can also tell those stories from other perspectives. For instance, our stories can be told from the perspective of a curriculum course, or a foundations course, or any one of the methods courses, etc. By doing so we can offer course participants a fresh perspective, open new perspectives and possibilities for ourselves, and further enhance the integration of technology into education. Experiences such as the one cited here are an attempt to do that.

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Launching an Internet-Based Master's Degree in Technology in Education

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In the fall of 1995, the Lesley College Technology in Education faculty decided to begin offering its graduate courses online, in addition to its traditional on-campus semester format, and off-campus intensive weekend format. By the fall of 1996, we realized that to reach a different audience than our two current formats allowed, we would have to offer all 11 courses that composed the master's degree. We developed a proposal to our dean, including a budget indicating the cost for supporting such an endeavor. The funds we requested were for course release time for converting our syllabi for online delivery, for short courses for the faculty to enable us to teach on both the Macintosh and PC platform, for books and software, and for the evaluation of the first cohort's experiences. The proposal was fully funded.

An online "Readiness Survey" (www.lesley.edu), created by another group within the school, was used to give potential students a guide for determining the program's appropriateness for them. The survey has two sections: "Technical Readiness" and "Disposition Readiness". In the technical readiness section we indicate the minimal computer configuration required for the program and ask questions about their use of key software and hardware tools. In the disposition section we ask questions such as access to a computer, ability to work alone and remain motivated, and willingness to persist in a technologically challenging environment.

The college's Office of Information Technology is very supportive of our efforts, having wired the campus last year with a state-of-the-art network. The Technology in Education faculty received networked Mac PowerPCs and PCs running Windows '95. The school acquired an Internet-based threaded discussion software, NetThread, which currently seems adequate for our needs. The college's president has made integrating technology into campus life one of her primary goals.

Pilot Courses

A sabbatical and a grant from the Sloan Foundation enabled us to pilot, and thoroughly evaluate, two graduate courses in the two years prior to launching the entire master's degree program online. An independent evaluator supported by the Sloan Foundation grant looked at both online courses, and, for the grant supported course, comparable sections being offered in the traditional semester format and intensive weekend format. The evaluation process included student interviews, review of email correspondence, a comparison of students' final projects, pre- and post-course surveys, and classroom observations. *Technology: Impact on Society and Schools* (ECOMP 6101) is a deliberative course based on reading and reflection. *Teaching and Learning with Multimedia* (ECOMP 5016) is a methods course which considers the effective application of technical multimedia skills.

Both online courses were structured as 14-week semester classes. The syllabus specified a weekly set of technical tasks and/or readings. Texts and readings were sent to the students ahead of time. For the multimedia course they also received software and video tutorials on its installation and use. The students corresponded with the instructor about the weekly tasks via email, and any assigned work was submitted via FTP to a college server for examination and evaluation. Discussion of educational concepts, experiences, methods, and issues followed the syllabus topics and was conducted on the course internet discussion forum.

The courses required a technical infrastructure, both by the college and by the students, to support the offerings. For the college this consisted of computer servers for web pages, email, and discussion forums. It also required support personnel to maintain the computer servers and services, and a knowledgeable instructor who could troubleshoot student technical problems. The technical requirements for students included a suitable computer and

peripherals and an internet account with web browser and email. The technical knowledge needed by the instructor included a variety of web browsers, email programs, internet service providers, FTP applications, online discussion forums, and word processors.

The students enrolled in the courses for many reasons. All students were matriculated in the Technology in Education Master's degree program. They represented all regions of the United States, as well as on-campus students. The most common reasons for enrolling in the online courses were "flexibility of scheduling, ability to accelerate study, and the need to learn how to conduct online learning." (Peake, p. 5; Moon & Peake, p. 10).

The students reported a number of benefits received from learning in the online mode. These included "flexibility of scheduling and pace, technology learning by doing, ability to work independently, equal participation by all, convenience, and learning style fit." (Peake, p.5) The reported challenges were "dependence on technology, lack of immediate interaction [these were asynchronous courses], volume of email, dependence on text material, and sense of progress." (Peake, p.6; Moon & Peake, pp. 24-29)

Online learning is different from other "classroom" environments. When asked to assess the differences, online students responded that the courses "had less intense interactions, more responsibility on the learner to attain content, more conducive to reflection, more access to instructor, more equal participation by all, more time consuming - but at one's own schedule." (Peake, p.6; Moon & Peake, p.37-42)

The evaluation analysis suggests that the online students "achieved the same level of competence" (Moon & Peake, p.43) as the students in the two more traditional courses. Moreover, the independent learning environment clearly suited the students who chose the online format. However, there was an indication of some feelings of isolation and a difficulty in creating a collaborative learning environment to support discussions and group work. "For while we know there is the technical capacity to deliver courses in an online format, the issues surrounding pedagogy and challenge of building virtual learning communities are formidable." (Moon, p. 7)

Online Master's Degree in Technology in Education

The online master's degree in Technology in Education is designed for students who are interested in learning about technology and ways technology supports education. Founded in 1979, Lesley's Technology in Education program has been developed by faculty, all with K-12 and college level teaching experience. The requirements for the degree, in any format, are identical. Class size, also standardized throughout the program variations, ranges between 20 and 24 students. Required courses include:

Computers, Technology, and Education
Telecommunications: Curriculum in a Global Context
Teaching and Learning with Multimedia
Integrating Technology into the School Curriculum
Fundamentals of Computer Structure
Technology and Special Needs
Microworlds, Models, and Simulations
Technology: Impact on Society and the Schools

Elective courses, of which three are chosen, include:
Technology in the Mathematics Curriculum
Technology in the Language Arts Curriculum
Creating an Educational Environment with Logo
Creating a Multimedia Curriculum using Authoring Languages
Video as Educational Technology

Recruitment of Students

Recruitment of online students differs from traditional recruitment in two important ways. First, we strive to reach an audience that otherwise would not be able to take our courses. Although we have off-campus courses in many states across the country, our online courses can be taken by students in any state or country in the world. Also, students whose life styles or physical challenges prevent them from traveling, can participate in our courses from their homes. Access to the appropriate technology is more important than geographical location or physical mobility. Second, attracting students can be accomplished without a mass mailing of a printed brochure. No mailing list includes as thorough a list of potential students as the audience of the millions of people using the Internet.

Face to face information meetings are not required to answer questions from potential students. Many of our potential students hear about our program electronically, by visiting our Web Page. Others are still responding to a simple, one page flyer sent to a small selection of international schools. Almost exclusively, email is the chosen method of communication when potential students need additional information. Questions are answered individually, usually leading to the registration and application process. One important step in the process is the online Readiness Survey at our Web site. Here interested individuals assess their potential for success in an online program by taking an honest look at their learning style and technological skills. If they consider themselves good candidates for the program and want to enroll, students can register for courses using a form on our Web Page. Application for matriculation in the master's program must be done using traditional mail because of the security required for transcripts and references. Administrative information about future courses, deadlines for registration, and other program related issues are posted on a Web page.

Management of Program

Once a course begins, materials are sent to students in a variety of ways. Our students live as far away as Asia and as close as the next town. When materials include papers and software, local students pick them up at Lesley College. United States students are sent materials by traditional mail. A costlier, international courier service is used to mail materials to our students living outside the U. S. Some courses do not require materials to be mailed. Readings and assignments are accessed through faculty Web pages.

Throughout the courses, electronic mail is a primary source of communication and a method of sending assignments and clarifying course objectives. In some courses, students are required to send weekly journals and progress reports. Class discussions take place using NetThread, an asynchronous discussion software that the college supports. Discussions are password protected and students participate in a variety of ways. Formal dialog takes place following a question posted by the instructor or one of the students. Topics include reaction to reading assignments or a discussion of a controversial topic in the news that relates to the class. The discussion area is sometimes used as a bulletin board where student reports are posted to share research. Informal dialog takes place anytime on any topic that a student or the instructor posts.

Video conferences, using public domain software and inexpensive cameras have taken place several times, with subsets of a class visiting a public or private reflector site. Students can see each other in small windows on their computer screens and communicate with each other by typing messages or through their microphones.

Comments on student work and assessment of student projects are done by email or traditional mail. Grades for courses can be sent by email but an official grade report will be sent by traditional mail after the course. The management and administration of the online program is different from a traditional setting but the access to email, Web pages, conferencing, and traditional mail combine to support communication between and among students and faculty as well as the sharing of materials.

The online program is being offered on a year-round calendar. Students study two courses in each of three academic terms—fall, spring, and summer. The first two courses, offered in the fall of 1997, are *Computers, Technology, and Education* and *Telecommunications: Curriculum in a Global Context*. In the spring of 1998 we offer *Integrating Technology into the School Curriculum* and *Teaching and Learning with Multimedia*, and so on throughout the degree. If the students continue at this pace, the first cohort will finish in the summer of 1999. However, students do not need to travel through as a cohort. Our first group consists of students from the U. S., Mexico, Malaysia, and Kuwait. Because of the number of inquiries for the online program, we are beginning a second round of courses in the spring semester. We plan to look carefully at the amount of growth we can sustain as we proceed.

Based on the findings of the evaluation from our pilot courses, the faculty teaching the first two courses are making a special effort to: make our syllabi very clear; intentionally require online discussion; and intentionally require some assignments, such as a software evaluation, to be done collaboratively. In addition, we are trying to identify as many resources, such as online readings and software demonstrations, to eliminate copying and mailings and encourage our students to develop a comfort exploring the Internet.

What we have learned

Learning began before the first class. One of the courses required that a package of materials be mailed to the students. Due to last minute registrations, we were sending out packages until a few days before the class began. To get the materials to the students on time, we had to use courier services thus increasing our mailing costs. In the future we plan to have registration end several weeks prior to the start of classes. Also, whenever possible, we plan to design the first week of the course to be free of special materials.

Both courses were developed in great detail. The syllabus for one course was an ever-expanding web page, while the syllabus for the second was a lengthy printed handout. We are finding that assignments, in particular, require great specificity. Students in our traditional classes ask many clarifying questions. Online students ask questions too. They want both further explanation of assignments and more clarity on grading criteria.

We realize that downloadable online readings are vital to the program. Online readings avoid the copyright issues of duplicating articles and they have no cost to the College. In the course, *Computers, Technology, and Education* we used many online readings. There were problems. Readings disappeared between August and October. In one case the web site disappeared and in another case the reading was no longer available to download. To minimize the problems, we are working with a librarian to find good sources of online material. The telecommunications class had success ordering books from *amazon.com*, the large online bookstore.

In the telecommunications class, students were required to send weekly journals. Many assignments involved reading and exploration, and did not result in a product, such as a paper or program. The journals were the only method of assessment. The more thoroughly the journal related to the task, the more positively the instructor evaluated the student work. When the instructor did not "hear" from a student for more than a week, the instructor questioned the student's effort. In fact, there were times when servers malfunctioned and the student's email did not get through. We learned not to rush to a judgment when students are out of touch. Silence can be misinterpreted.

In *Computers, Technology, and Education* students submit a variety of assignments with one due each Monday. Since this is a survey course the assignments range from making a timeline, to writing a newspaper, to creating a database, to programming in Logo MicroWorlds. In most cases students submit their work as attachments. It takes a few weeks for all the students to learn how to send attachments. Some students work on Macs and some on PCs. They also use a variety of email and word processing programs. We learned a lot sorting out the different file types. One student project consisted of twelve files! Putting projects in a format suitable for grading is incredibly time consuming.

In the telecommunications class, most of the students were able to solve their own technical problems. They found local resources in the form of other people, manuals, and customer support numbers. Though encouraged to post problems publicly in the class conference area, they rarely did. Some admitted that they were embarrassed to confess to having trouble. They were more likely to post their questions on a large, public newsgroup.

Both classes consist of self sufficient, independent learners. The students solve most of their own problems. We are aware that subsets of each class emailed back and forth and help each other. In only one case, did large numbers of students post their problems for their classmates to see. Faced with programming in Logo, students posted their questions to the class via email. What happened was wonderful. Classmates responded; they answered the questions in great detail. The feedback provided was quicker than the feedback from the instructors. All the students learned from the questions and they put the information to use in their own programs.

We want to develop more meaningful ways for students to work together. Both classes have group projects. In general the projects work well. However, we realize we need to develop methods to facilitate online group work. We also have to develop techniques to handle situations when groups are not functioning and the participants are angry with one another. Naively, we never considered that students would become angry with each other. Both courses use NetThread to facilitate online discussions. The students use this system to complete assignments. We need to work towards more fluid NetThread discussions. All courses in the eleven-course sequence require collaborative work and online discussions.

Most of all we have learned that teaching in this manner can work. The framework the faculty lays out for a course is critical. After the course begins, the faculty becomes a guide, a resource, and an assessor. Teaching in this manner is extremely time consuming. We are very conscious of the additional time it takes to develop the syllabus, identify online resources, and respond to students' email. We estimate this to be about twice that associated with a traditional course offering. Thus far the involved faculty find the experience of teaching online both exciting and rewarding. We are carefully evaluating this first online cohort to insure the academic quality of the program.

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Marketing for Distance Education: A Five Stage Plan

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As distance education becomes more prevalent in society, training programs, educational programs, schools, and universities have the opportunity to offer instruction to students throughout the world. With the increased use of the Internet, distance education is becoming an international activity. This is one of the benefits of distance education that has appealed to many educational leaders. Matriculated students are no longer limited to those who can physically be present in the classroom. This opens the door to many new opportunities for educational institutions to provide instruction to an international body.

However, the fact that an educational institution offers distance education courses does not mean that they will automatically have increased enrollment. For this to happen, it is crucial that a well conceived marketing plan be established in coordination with the delivery of the distance education instruction. The development of a well conceived marketing plan for distance education courses is the basis of this paper.

A Distance Education Program

The authors currently serve as faculty in the Educational Technology Leadership Master's Degree program delivered entirely via distance education at George Washington University. This program is designed for individuals who want to lead the way in improving teaching and learning in education and training settings through the application of educational technology theory and practice. The program makes use of many technologies including satellite television, video, e-mail, World Wide Web, and NetForum software.

Students can choose to take individual courses or enroll as degree students. The course credits and degree are no different than those awarded to on-campus students. The program has an enrollment of approximately 270 students. Most of the students have full-time jobs as teachers, educational administrators, media coordinators, instructional developers, active duty military, or training specialists. The program has been in existence for eight years. The program Web site can be seen at: http://www.gwu.edu/~etl

A General Overview of Marketing

Marketing is one of the essential ingredients utilized by organizations in their never-ending search for survival and growth. In most cases, marketing attempts to generate profits from the sale of goods and services to fill customer needs. Most basic marketing systems contain three components: 1) an organization, 2) a delivery channel, and 3) a customer (Dalrymple and Parsons, 1983). Additionally, at the root of every market-driven economy there are four central ideas:

1. Individuals strive for rewarding experiences.
2. Individual choice determines what is rewarding.
3. It is through free and competitive exchange that individuals and the organization they deal with will best realize their objectives.
4. The mechanisms of the market economy are based on the principle of individual freedom, and more particularly on the principle of consumer sovereignty (Lambin, 1993).

With all of this in mind, Lambin (1993) defines marketing as a "social process, geared toward satisfying the needs and wants of individuals and organizations, through the creation of free competitive exchange of products and services that generate values to the buyer" (p. 5).

For distance education, we have modified the previous definition slightly to better incorporate the instructional environment. We see distance education marketing as a "social process, geared toward satisfying the needs and wants of the learner, through the creation of free competitive exchange of instruction that generates values to the learner."

A Five Stage Plan

As we have gone through the marketing process for our own distance education program, we have developed a five stage plan for implementing our marketing goals (see figure 1). This plan is very iterative in nature. As the distance education arena, our program, and technology in general change, the plan is re-evaluated and revised if necessary.

Stage One - Identifying Demographics

The first stage in developing the marketing plan is to identify the demographics of your proposed student population. This includes their background and experiences, future goals (i.e., why do they want to take the courses you

offer), and their geographic location. This stage must be completed first, because each of the other four stages are dependent upon it.

A good avenue for collecting this type of information is to do a survey to determine the demographics of your current students. This information will provide you with a good starting point if you attempt to advertise to students similar in background to your current student population or if you attempt to advertise to a new demographic group.

Stage Two - Identifying Key Information-Providing Resources

Once the demographics of the proposed student population have been developed, the next stage is to identify the key information-providing resources for those students. These resources could include newspapers, magazines, journals, special publications, online (Internet-based) advertising, radio, and catalogues of distance education courses.

Again, a good starting point to collect this type of information is your current students. You can conduct a survey to see when and where they get their information. After these key resources are identified, the approximate advertising cost for each resource needs to be obtained. Many times, a discount can be arranged by working through the marketing representative for the educational institution.

Figure 1. A Five Stage Marketing Plan for Distance Education

Stage Three - Evaluate the Options

After the key information-providing resources and their costs have been collected, the next stage is to evaluate each option. This stage will vary depending of the available budget of the educational institution. After reviewing the budget, sometimes the more costly advertising options can automatically be eliminated. The remaining options can be evaluated using data from the advertising resource themselves. For example, newspapers can provide an estimated number of daily readers and World Wide Web sites can tell you how many hits they have had in the past on a particular page.

Advertisers can also tell you what type of person is exposed to their advertising. For example, a business-oriented publication would be better than a cooking publication if you are interesting in advertising to potential students interested in enrolling in business courses. This data can be used to determine which of the advertising options will best fit the needs of the educational institution.

Another important issue at this stage is how much of your budget you want to commit at one time. Do you want to advertise throughout the year or only during specific times (e.g., the month before registration)? Do you want to spend most of your budget on one particular advertising option (e.g., television) or do you want to spend it on several less costly alternatives?

Stage Four - Prepare and Run the Ads

Once the best information providing resources have been identified for the educational institution, the next stage is to prepare and run the ads. The placement of the ad and its appearance can have a profound impact on the reader's response. Therefore, it is important to work with a professional when preparing the ad. Many times the educational institution will have a marketing representative who can assist in this area. It is also important to verify that the ad is run when and where specified.

In conjunction with this stage, you need to make sure that you are prepared for the response to your ads. If your ads are successful, your point of contact may be overwhelmed by telephone calls, e-mail, faxes, and mail. You need to make plans in advance for this issue. Options could include hiring and training a part-time employee to handle the inquiries or installing a second phone line. Finally, make sure the content of the ad is correct (incorrect contact information can be very costly).

Stage Five - Collect Feedback and Revise

The last stage of the marketing plan is to collect feedback and revise the plan. The purpose of collecting feedback is to determine where the matriculating students are finding out about the distance education course or program. The best way to collect feedback is to ask the student this question at one of three possible times: 1) when they first contact you, 2) when they register for the course, or 3) on the first day they participate in the course.

The feedback that is collected serves as the ultimate evaluation of the marketing plan. It may turn out that one of the information-providing resources is much better or much worse than anticipated. Once this data is collected and reviewed, it is then important to revise the overall marketing plan to reflect this information. Marketing coordinators for the educational institution can then go back to stage two or three to incorporate these changes.

Conclusion

In general, marketing is an important tool that educational institutions and others offering distance education courses can use to attract students from an international body. Whether a marketing plan is successful or not can have a tremendous impact on the growth and survival of a distance education program. Therefore, it is important that a well developed marketing plan be implemented early and followed.

This paper reports on a five stage marketing plan that has been developed based on the experiences in our own distance education program. The five stage plan can serve as a starting point from which successful marketing can be implemented. Marketing plans should be periodically evaluated and revised based on the ever-changing distance education arena and technology in general.

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A Project-Based Computer Certification Program for K-12 Educators

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As enthusiasm for the educational use of the Internet and the WWW in education grows, educators would do well to re-examine the current status of the computer in the classroom. Just as the Internet and the WWW are now seen, computers were often promoted as a "silver bullet" which would transform education. Tens of millions of dollars were invested in efforts to bring computers into the classroom, often utilizing funds meant for the more fundamental but less glamorous resources such as textbooks, library materials, and school maintenance. As the enthusiasm for "on-line schools" grows, a number of authors have begun to re-assess the impact of computers on education.

Mergendoller (1996) noted that the most common uses for computers are "drill and practice in elementary schools and word processing in secondary schools" (p. 43). Jonassen (1996) reported the results of surveys showing that almost 85% of software in use in schools is for drill and practice or for "tutorial software that was designed to support rote learning" (p. 15). Mergendoller further suggested that these are the uses which fit most closely with existing teaching and curricular practices, indicating that computers have not transformed the classroom, but have been "transformed" to fit existing school practice.

Stoll (1995), in his popular work, *Silicon Snake Oil*, saw possible causes for this problem as: a lack of good educational software, problems with the technological aspects of computers, rapid development in technology making machines outdated within a year, and the lack of teacher training. A recent survey by the U.S. Department of Education reported that only 15% of the nation's teachers had nine or more hours of instruction in the use of educational technology. The survey also noted that the need for computer training is especially critical among veteran teachers, certified before computers became common in classrooms (Free Lance-Star, 1997).

Audet and Abegg (1996) suggested that "introduction of technologies into schools often follows a linear path from invention of the software to formation of educational applications" and that:

> Curriculum materials and instructional approaches elaborated before suppositions about the relationships between students, computers, [software], learning tasks, and instructional styles are tested may suffer fundamental flaws. Ideally these concerns should be addressed *before* [their emphasis] the technology is in place (p. 22).

As new computer-based technology, such as the World Wide Web, appears in the classroom, the issue of developing a meaningful educational role for the computer will become more critical. It should be obvious that any such development must take place in cooperation with classroom teachers who will be using the technology in their classroom, and it must occur in that same classroom environment. Just as obvious should be the realization that worthwhile use of these resources does not involve "classroom business as usual, but the enactment of a complex new managerial and instructional role (Mergendoller, 1996)." Owston (1997) states the issue clearly: "[T]he days of frivolous experimentation in schools have long passed. Before we introduce any new technology into our classroom we must be able to justify its contribution. The public expects no less of us" (p. 33).

Technology Standards

In a number of school districts and states, the issue of developing meaningful educational applications of technology has been forced by the adoption of standards of learning. The Virginia State Board of Education has developed such technology standards as part of the State Standards of Learning, which will be in force as of July, 1998. These technology standards list the computer competencies which are to be met by students at the end of grades five and eight.

These competencies include: (1) the use of application software such as spreadsheets, databases, desktop publishing, and word processing, to produce reports and documents, (2) the ability to communicate through networks and telecommunication, (3) the ability to create "home page" documents that can be accessed by worldwide networks,

and (4) the ability to store, process, retrieve, and access electronic information.

If educators are to help their students achieve the levels stated by the standards, then it is obvious that these educators must possess an equal or higher level of skill than their students in order to provide instruction in areas. The State Board of Education recognized that fact and proposed corresponding Standards for Instructional Personnel that described the technical proficiencies required for licensure in the Commonwealth of Virginia. School districts are being directed to incorporate the use of technology into staff development programs, and to consider applicants' abilities to use these skills as new staff members are hired. In addition to the skills listed in the student standards, instructional personnel must be able to: (1) plan and implement lessons and strategies that integrate technology to meet the diverse needs of learners in a variety of educational settings, and (2) demonstrate knowledge of ethical and legal issues relating to the use of technology.

Description of the Program

The Computer/Technology Certificate Program was developed by the School for Continuing and Graduate Education at Mary Washington College, with participation of personnel from area school districts and Mary Washington College, in response to these new State Technology Standards. The program was designed for Virginia educators, including teachers, administrators, media specialists, and technical support staff, who feel that they either do not possess the skills mandated by the standards or do not possess them in sufficient degree.

The program consists of a sequence of five, one-credit courses. Four of the courses are "core courses", addressing specific technology standards. The fifth course is an elective which teaches a technology skill not directly stated in the Standards, but which is still of value to any educator working with computers in the school. The four core courses are:

1. Implementing the Computer/Technology Standards - a discussion of the State Computer/Technology Standards and an overview of the Certificate Program,
2. Introduction to the Internet and World Wide Web (WWW) for Educators - an overview of the educational resources available on the Internet and the WWW,
3. Introduction to Desktop Publishing and Multimedia for Educators - an overview of specific applications using Desktop Publishing and Multimedia software and associated hardware, and
4. Implementing Technology into Instructional Programs - provides participants with a basic understanding of the instructional applications of modern technology.

The two electives currently offered are:

5. Implementing a Technology Plan for School, Department, or Grade Level - provides a basic understanding of computer technology, including research and selection of appropriate and software for the classroom and/or department, and
6. PC/Software Maintenance and Troubleshooting Techniques - provides participants with a strong, non-threatening approach to basic troubleshooting techniques and preventive maintenance procedures for hardware and software.

The program has recently added an additional course, Basic Computer Skills, as a supplement to the program rather than as a requirement. Many teachers wished to participate in the program, but were unable to meet the minimum requirements: experience in completing tasks such as finding, opening, copying, and saving files, using floppy disks, and familiarity with a word processor.

While teaching the skills needed to make use of the different types of software and hardware associated with these courses is important, if we were to avoid some of the problems reviewed in the introductory section of this paper, the program developers felt that it was critical that the skills be taught with an emphasis on integrating these tools into the teachers' daily classroom instruction. Classroom teachers participating in the program are asked to bring a frequently used unit or lesson plan to the first course, administrators a plan for technological development, media specialists a survey of current technology uses, and technical support staff a training program or equipment "wish-list". The participants then enhance this unit or plan throughout the sequence of courses, making use of Internet and WWW resources and contacts, utilizing desktop publishing software and hardware to better present their plan, and then bringing all resources and skills together in the final course to produce a technologically "enhanced" unit, program, or plan.

Close collaboration with local school districts has led to the development of specifically designed training schedules for many teachers. The Fredericksburg (Virginia) Public School district has arranged to have at least 75 teachers take part in the certification program, providing a cadre of 25 trained teachers in each of the 3 district schools. These teachers will take the courses, as a group, both during spring semester courses and in intensive summer training sessions.

Program Assessment

Several research questions have guided this study. They are: (1) What are the levels of background computing experiences that K-12 teachers have as they enter the certificate program?, (2) What are K-12 teachers' perceptions of, and opinions of, the individual courses as they complete them?, and (3) What are the experiences, and resulting changes in perceptions and attitudes, of these K-12 teachers as they complete the certificate requirements?

While a small number of courses have already been taught, one entire sequence of courses will not have been completed until January, 1998. We have found that offering a "staggered" schedule, with several sessions of the first few courses provided each month, seems to better fit educators' schedules. Data collection, analyses, and interpretations from the first group of participants will be completed by January, 1998. While our presentation will report on the results of one entire sequence of coursework, this paper will describe our methodology.

Participants

While the program is open to all Virginia educators, the majority of our participants have been classroom teachers from the surrounding school districts: Fredericksburg city, Spotsylvania, Stafford, Caroline, and King George counties. There has been a balance, up to this point, of elementary and secondary teachers. No trends in terms of subject area have been noted, with roughly equal numbers of science, math, and humanities teachers represented.

Data Sources

Data currently being collected, analyzed, and interpreted consist of: (a) surveys of perceived computing skill levels, collected at the beginning of the initial course, at the beginning of the third course, and at the conclusion of the sequence; (b) course evaluations and comments; and, (c) focus group interviews with participants. Initial results seem to indicate that participants are highly satisfied with the program's approach of teaching skills in an educational context and believe that their skill levels do increase.

The survey of perceived computing skills asks the participant to rank order their knowledge, using a 0 - 5 Likert scale, of various computer applications. Areas examined include their knowledge of hypermedia software, spreadsheet software, web browsers, and e-mail. They are also asked to respond to short answer questions regarding their years of computing experience and types of computer used. After completing the computer experience survey, participants are also asked to complete a survey of Attitudes Toward Using Computers. This survey consists of 35 statements, all ranked in terms of agreement using a 0 - 7 Likert scale, with 0 indicating "Not true of me now" and 7 "Very true of me now".

A course evaluation form is provided to participants at the end of each workshop. This instrument addresses the following areas: course instructor, course activities, handouts and other documents, hardware and software used, and classroom use and links to the state Standards of Learning. There are 17 such statements on the form, each answered by a 1 - 6 ranking on a Likert scale. One question requests an overall course rating, with choices ranging from Very Poor to Excellent. Participants are also asked to provide comments and suggestions on the back of the evaluation form.

Participants in focus group interviews will be identified based upon varying degrees of background computing experience and their levels of satisfaction with the course. We hope to discuss several issues with participants who are highly experienced and with those who are relatively inexperienced with computers, as well as with some individuals who are highly satisfied and with those who might be less satisfied with the course. The issues addressed in the groups will include perceptions of usefulness of the hardware and software used during the program, issues regarding classroom integration, and relevance to the state Standards of Learning.

Analysis of the Data

Background computing experience. Self-report information will be descriptively analyzed to describe the participants. A primary purpose of this data collection is to establish a baseline from which future comparisons can be made. For example, if teachers are coming to the courses with increasing levels of word processing experience, this aspect of the course could be downplayed to allow more time for "high-end" technologies to be explored. Course revisions such as these will be required to maintain current content. We've set 18 months as the *window* that K-12 teachers have for completing the series of courses leading to the certificate.

Course evaluations. The results from the course evaluations will be quantitatively described using summary statistics, charts, and graphs. By examining the results from the course evaluation forms, we will be able to determine which aspects of our program are perceived as being most effective and which are least effective. This information might also provide some ideas as to where teachers might most often see "problems" in using computers: hardware, software, or classroom integration. The course evaluations will also provide a "real-time" monitoring function, enabling course developers to learn from each course experience, and make modifications as they are required.

Focus Groups. Transcripts from the focus group interviews will be reviewed and examined for emerging concepts and themes.

Our Presentation

Due to the fact that we are still collecting data, and will be for the next few months, this paper will differ in some ways from our presentation. In this paper we have attempted to provide a rationale for our project, and a description of our approach to solving a well-known problem: the meaningful use of computers in education. Our presentation will consist of (a) providing an overview of the courses within the program, (b) the rationale for selecting the courses and the project-based approach that we are using, and (c) some examples of student projects from the first few courses that have been completed. Research results will also be shared through our presentation.

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Technology Mentorship: A Model for Faculty Development

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Computers offer a promise of change to our educational system much the same as the book changed education, by allowing storage of information over time and place (Moursund, 1992). They have impacted almost every aspect of society. However, schools today remain much the same as they were forty years ago, little changed by the possibilities provided by the technology (David, 1991; Ingram, 1994).

According to Cuban (1986) the teacher is the gatekeeper of innovation, for it is the teacher who must implement the innovation. The teacher is the key factor in using technology to bring about positive change. But how do teachers become the innovator? Teacher education must provide the skills, knowledge, attitudes, and models for teachers. Teacher education programs are the catalyst for change (Ingram, 1994).

Teacher education institutions have a unique opportunity to prepare teachers to use technology in ways that bring about positive change. The International Society for Technology in Education (ISTE) has developed a set of standards for preservice teachers. These standards include goals in three major areas: basic knowledge of computer operations and concepts, personal and professional use of technology, and integration of technology in instruction.

If preservice teacher education is to make a difference in how teachers use technology then teacher educators must model effective technology use. As seen in several models of faculty development at teacher education institutions, faculty can integrate computerized lessons and presentation software into existing curricula; use e-mail to communicate with students, colleagues, and professional organizations; utilize application software for preparing student materials, recording student progress, and calculating grades; and integrate the Internet into class resources (Ennis & Ennis, 1996; Topp, 1995).

According to the Office of Technology Assessment (OTA) report *Teachers and Technology* (1995), too few faculty are modeling instructional methods that integrate computer technology into teacher education courses. As indicated by Ingram (1994), the missing ingredient is a college and university teacher education faculty that is sufficiently technologically literate to accomplish these goals. However, faculty are reluctant to use computers in preparation and delivery of courses (Ennis & Ennis, 1996). Several barriers to faculty development are identified in the literature: lack of access to adequate hardware and software, lack of active support from administration, time constraints, limited recognition of the potential of technology in education, and faculty who are uninterested or unwilling to take the risk and make the commitment (Roberts & Ferris, 1994; Staman, 1990; Wetzel, 1995). Other barriers to the integration of technology in teacher education courses are found within the K-12 education community. These include the lack of a clear, generally accepted vision for the role of technology in education, lack of enough technology in the schools for it to make a difference, and lack of adequate teachers to be role models for student teachers (Roberts & Ferris, 1994).

Faculty resistance may also stem from insecurity and fear. Replacement of teachers with machines was a concern from the early days of technology development. However, change may be more threatening than replacement.

The threat from technology may, in fact, result more from an anticipated role change than from the fear of being replaced. The effective use of technology within the organization of schools may require changes in the curriculum, the way in which teachers transmit the curriculum, the way in which students learn, and the way in which schools operate. And each of these changes implies a change in how teachers do their work. A sense of efficacy comes from work well done. To change the way professionals are expected to do their work threatens their sense of efficacy. This may make individuals particularly resistive to change. (Harrington, 1991, p. 50)

There are several strategies that have proven successful in effecting changes in the use of technology in education. At the University of Nebraska at Omaha a model for faculty development for technology integration was built upon three key elements: availability of equipment, faculty training, and expectations of utilization of technology in

academic activities (Topp, Mortenson, & Grandgenett, 1995). Faculty training focused on awareness, experience, and integration and was provided through overview and summer intercession sessions, brown bag lunch presentations by other faculty, focused sessions with follow-up coaching and encouragement, and experiences in "supportive and comfortable 'hands-on environment' with knowledgeable individuals available for assistance" (p. 13).

Team teaching courses in which professors of subject area methods courses were paired with technology faculty or teaching assistants with strong technology backgrounds is one effective strategy (Roberts & Ferris, 1994, Robinson & Milligan, 1997). At Lesley College Graduate School of Education the computers-in-education faculty developed a program to integrate technology into teacher education by team teaching. Similarly, at the University of Tennessee a course was developed and taught by a mathematics education professor and an educational technology graduate student (Robinson & Milligan, 1997). Benefits for the faculty member included increased skill in the use of networks and web-based materials. Benefits for the graduate student included developing relationships with faculty, learning how to teach by coaching rather than lecturing, and developing confidence and experience in team teaching skills.

Other successful models that include mentoring and one-to-one tutoring have been used as part of on-going faculty development both in K-12 and higher education settings (Beisser, Kurth, & Reinhart, 1997; Farley, 1992; Gonzales, Hill, Leon, Orrantia, Saztin, & Sujo de Montes, 1997; MacArthur et al., 1997; O'Bannon, 1997; Pryor & Bitter, 1995-96). In the "Learning Technologies Program" (Gonzales et al., 1997), masters and doctoral students mentor faculty members two hours a week after setting specific goals. Since equipment availability is often a barrier, this program has made available a multimedia teaching classroom and near-by labs with Mac and IBM platforms. The program benefits both the faculty and the students. Students gain experience through interactions with different faculty members, who share expertise and model effective behaviors of faculty activities.

Zachariades and Roberts (1995) describe the process and the benefits of a collaborative effort between a graduate student in instructional technology and a language arts faculty member. The graduate student was enrolled in a seminar-type course in which one assignment was to help faculty integrate technology into their content area. Together they designed a plan of action that began with awareness and comfort, moved to experience, then integration and modeling of technology use in the course. The success was due to the individualized nature and self-paced workload, focusing on the specific needs of the faculty member.

Undergraduate students can also be effective mentors of technology skills. Beisser, Kurth, & Reinhart (1997) describe a single student-single faculty situation in which the team met for one hour each week focusing on the integration of technology into a specific course. Communication was maintained through interviews, observations, journals, and e-mails.

Ennis and Ennis (1996) outline 12 ways to motivate technology use that includes elements similar to the programs described here. These include the use of peer coaching, avoiding the one shot approach, basing the development on the faculty member's own needs and choices, and providing technical support at the time that it is needed. Individualization of plans and availability of support are critical to success.

As emphasized in these models and others, the key elements of mentoring relationships include effective needs assessment and advanced planning, positive reinforcement, attention to personal goals, and communication (Beisser et al., 1997; Pryor & Bitter, 1995-96). The purpose of this project is to meet a critical staff development need at Carson-Newman College for technology training. Our goal is to develop, implement, and evaluate a faculty development model that makes the use of the best elements of these models and strategies. Following is a discussion of the design, description, and implementation of this mentoring project. The project is directed by two teacher education faculty, one is an educational technology specialist at Carson-Newman College and one is a subject area specialist at the University of Tennessee, Knoxville. This team approach provides a view from the inside and outside and a focus from a technology specialist mentor and a faculty mentee.

Description of Project

The faculty development model that we designed sought to formalize the key elements of mentoring relationships. Faculty members will be able to have individual help in their own offices on skills they want to learn. Students will work with faculty individually to develop teaching and mentoring skills. They will also develop new technical skills as they help the faculty member.

As the mentoring relationship develops, the student technology mentors will have the opportunity to observe the faculty member use their newly developed technology skills to do their job. From this mentoring relationship, they will observe first hand what it means to be a teacher. The experienced faculty member then becomes a mentor to the student as he/she develops an understanding of teaching as a profession.

A key element of the project is a formal commitment to the mentoring relationship on the parts of both the faculty and the student. For the faculty member this means signing a formal agreement to work with a technology student mentor

for at lease eight hours during the semester. An optional activity for the faculty is a request for them to keep a journal of their experiences in the project. For the student the commitment was fulfilled by participating in a one hour credit course. The course used the first semester was a pre-existing education department, pass/fail, independent study. During the first semester of implementation the course was submitted to the appropriate committees for acceptance as a regular, graded catalog course with the title, Technology Mentorship. This was done to allow the course name to appear on the student transcript as a way to further give the students credit for their participation in the project. The participation agreements formalize the commitment that is necessary for mentoring relationships to be successful.

The activities in the course are designed to provide the students with a structure to use as they begin serving as a mentor. The course syllabus contains five requirements. The first requirement concerns time. Students are required to spend 30 clock hours mentoring. Each student devises their own way of keeping up with their hours. In addition to time spent with faculty members, mentors also include time they spend preparing for the course, keeping a journal, attending mentor meetings, and learning any new skills.

In addition to the contact hours, the students are required to conduct a needs assessment with the faculty members who have chosen to participate in the project. The process of conducting a needs assessment is discussed in the first mentor meeting. The third course requirement is for the students to work with their assigned faculty to develop a set of technology learning goals and a plan for meeting these goals. The plan is to include a brief description of the topics to be covered in each session with the faculty member.

Students are also required to keep a journal of their experiences as a mentor. In the journal the students are directed to give a brief summary of the meeting, problems they might have encountered, as well as a reflection on things that they learned about teaching and learning. The final course requirement is attendance at mentor meetings. There are four of these scheduled throughout the semester The purpose of the meetings are as follows: two meetings at the beginning of the semester to get the project underway, one in the middle to discuss their mentorship experiences, and one at the end of the semester to evaluate the project. These requirements, especially the journals and mentors meetings, serve as a major means of formative evaluation of the project. During the semester break the faculty will be interviewed about their experiences in the project.

Implementation

Five students participated in the first semester of the project. These students were selected from students who had taken the educational technology course required for all education majors and from education students who regularly used the department computer lab. The on-site project director teaches this course and manages the computer lab. Four of the students were undergraduates majoring in education. One was a graduate student in the Masters of Arts in Teaching program, a program designed for students with an undergraduate degree in a field outside of education to receive a license to teach as a part of the degree. There are 11 full-time faculty members in the teacher education department at Carson-Newman. All faculty members, except one were able to participate in the project. Due to scheduling difficulties, one faculty member was unable to begin participation in the project until after mid-term.

The students and the on-site project director examined the ISTE goals and several technology skills checklists for educators. On the basis of this examination, each student mentor developed a list of interview questions and chose a faculty member to interview. They also completed a journal entry in which they evaluated their own technology skills in light of these technology goals. After the initial needs assessment interviews were conducted, the mentors met to determine how the mentors and faculty were to be paired. As it turned out the students worked with the faculty members they interviewed. Initially students were concerned they would not have the technical skills they needed to mentor faculty. After the interviews they felt more confident that they did possess these skills necessary. Each mentor worked with two faculty members.

The student journals have become an important tool in implementing the project. Since all of the students were familiar and had ready access to e-mail, the journals were sent to the on-site project director via campus e-mail. Students e-mailed questions they had as they worked with their faculty member. They reported their successes as well as their frustrations. In addition to the students' e-mail journals, the on-site project director sent e-mails to the faculty asking them to describe their experiences. This was not a part of the original assessment plan, but was initiated during the semester as a way of encouraging faculty members to reflect on their experiences.

The mid-term mentors meeting served as a time for mentors to share their experiences as well as discuss problems encountered so far. A central aspect of the meeting was the syllabus requirement of the learning plan that was to be developed. None of the mentors had turned in a plan for the semester, even though they had outlined in their journals what they would cover the next time they met with their faculty member. They suggested that it was very difficult to write a formal plan because they did not know what to expect. Their prior experience of planning consisted mostly of writing single lesson plans for class assignments. They suggested that a structured format would be helpful in writing a long range plan.

The final course evaluation will take place at the end of the semester. It will begin with a meeting of the project

directors and mentors. The evaluation session will be conducted as a focus group led by the off-site project director. Questions to be discussed in the session include:

What did you gain from participating in the project?
Do you feel that you have met your planned goals with your faculty mentor?
What are your overall impressions of the project?
What would you change about the project?
Would you do it again?
What would help prepare you for participating in this project?
How did the on-site project directors' model of mentoring help you be a mentor?

At the request of the student mentors the participating faculty members will be asked to join the group discussion. They will be asked to share their perspectives as mentees, provide feedback on the benefits they have gained, and offer suggestions for the upcoming semester.

Next Steps

Based upon the formative evaluation available, preparations for the continuation of the project contain some changes in the course requirements. The course requirement concerning the development of a learning plan will need to be restructured. Some type of format will be provided to aid the students in developing the plan. There will be an increase in the number of mentor meetings. A critical problem that still needs to be addressed is the student's frustration with lack of faculty time and commitment to practice skills being developed. The formal evaluations conducted at the close of the first semester will be crucial in identifying some ways to deal with the issues of faculty time and commitment.

Another important change next semester will involve expanding the project to faculty outside the department of education and Carson-Newman College. New student mentors will have to be identified. Public school elementary teachers at a local school have also been identified who are interested in having a mentor. A mentorship agreement, similar to the faculty agreement, will have to be developed. Experiences gained from this semester and findings from research will continue to help us improve this mentor relationship.

The opportunity of teacher education institutions to prepare teachers to use technology to effect change is also the challenge for teacher education institutions. As projects are designed and implemented to assist in this endeavor, the ideas and results must be shared with others in order to continue the process in a positive direction. This discussion is one contribution to that effort, to that challenge, to that opportunity.

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Technology Education in a Teacher-Mentor Professional Program: A Case Study

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Teacher-mentors are needed to assist first-year teachers with the common problems/issues beginning teachers encounter (Martin & Reynolds, 1993; Niebrand, Horn, and Holmes, 1992). Mentors, serving as a professional colleague and friend, have the responsibilities of modeling successful pedagogical techniques to new teachers, assessing beginning teachers' instructional practices, and discussing strategies to improve classroom teaching. Moreover, teacher-mentors as adult learners want professional programs to meet their specific, lifelong educational needs for both professional and personal growth (Chickering, 1994; Cross, 1991). Lifelong learning serves as means for self-renewal in an ever-changing world (Collinson and Others, 1994). Consequently, public school and higher education officials need to collaborate in preparing teacher-mentors to serve as successful models and guides for beginning teachers, as well as to meet mentors' own professional needs (Rodriguez, Alaniz, Kajs, & Lira, 1993).

A critical component of this mentor-teacher preparation program is familiarity with technology, especially with its usage in the classroom setting. "Technology expertise can serve as a vehicle for educators to creatively explore with parents and community members ways to develop independent thinking, collaborative problem-solving, risk-taking, and multicultural sensitivity among elementary students" (Regional Collaborative Center for Professional Development and Technology Proposal, 1992, p. 4B-5). University instructors ensure that mentors demonstrate competencies based on the International Society for Technology in Education (ISTE) guidelines. Components of the guidelines include the ability to utilize computer/technology-based software/materials in a successful manner, to use computers to facilitate instruction, to demonstrate proficiency with word processing, spreadsheets, and print/graphics for both professional and personal use, to access information using computer-based technologies, and to practice reflective thinking about the application of current technologies in the instructional process (Regional Collaborative Center for Professional Development and Technology Proposal, 1992).

Assumptions in Developing the Teacher-Mentor Program

In developing a syllabus for the professional program for teacher-mentors, assumptions were made based on guidelines established for mentors by the certifying agency and on past experience working with teacher-mentors. First, participants were teachers serving as mentors for the first time or teachers who had not served as mentors within the past five years. The consequence of this was that teachers had never participated in a formal mentor education program or had not enrolled in a mentoring program within the past five years. Second, mentors would possess a diversity of instructional background and varying levels of proficiency with personal computers and related technologies. Third, teacher-mentors may or may not have computer technology available in their classroom and/or schools. Fourth, since the program would be delivered in late afternoon after teaching six or seven hours in the classroom, mentors could arrive fatigued for the mentoring program, thus influencing motivation levels. Moreover, attendance at the program could require long distances of travel by some mentors. The recommendation of weekend classes to address the issues of fatigue and distance was not an option due to the unavailability of human resources. Fifth, mentors may miss technology sessions due to campus obligations. Lastly, because of the availability of computers at the university, the computer education component of the professional program required the use of Macintosh computers. It was explained that while mentors may have IBM-compatible computers in their schools/classrooms/homes, participants could transfer Macintosh software experiences, e.g., E-mail, Internet to their IBM-compatible computers.

Teacher-Mentor Input in Developing the Professional Program

In light of the assumptions and the value of collaboration to meet professional needs of teachers, the professor solicited teacher-mentor input for the construction of the

syllabus. Mentors completed a questionnaire that requested mentor input regarding their backgrounds and experiences with computers and computer-related technology. The background information included the teacher-mentor's name, campus, district, and number of years as a teacher, grade level or specialization, and number of years as a mentor. The computer and technology-related information included the type of experience with personal computers; the number of computers in their classroom; the number of hours per week that teacher-mentors used personal computers; the accessibility to computers in the classroom and/or school and to the kinds of software used; and their previous attendance at mentoring courses or workshops, and if so, when. The questionnaire also asked mentors to respond whether they needed experience (i.e., NE) or had experience (i.e., E) with various computer programs/technologies. The list was based on the use of Macintosh computers because of their availability as stated earlier. The list included Macintosh Operating System, computer files and folders, E-mail, Internet, and TENET (Texas Education Network), word processing, spreadsheets, grade sheets, and database, Kid Pix/Kid Works, CD-ROMs, and Hyperstudio. The questionnaire also asked mentors to list any other computer-related issues they wanted discussed or practiced. The results of the survey guided the professor in developing the computer and technology-related lessons for the classes.

Technology-Related Software Utilized

In presenting technology sessions to teacher-mentors, the professor utilized a variety of software applications including *Netscape Navigator* by Netscape Communications Corporation, *Eudora* by QUALCOMM Incorporated, *ClarisWorks 4.0* by Claris Corporation, *Kid Pix* by Craig Hickman and Broderbund Software Inc., *Kid Works* by The Davidson Company, *The Writing Center* by The Learning Company, *SuperPrint* by Bruce Ballard, *US Atlas* and *HyperStudio* by Roger Wagner Publishing, Incorporated.

Teacher-mentors were introduced to a number of CD ROMs available from the university for classroom use including *Preschool Parade, Reader Rabbit 1, Reader Rabbit 2, Reader Rabbit 3, Sammy's Science House, Treasure Cove, Treasure Mountain, Scary Poems for Rotten Kids, The Tale of Peter Rabbit, The Velveteen Rabbit, The Adventures of Pinocchio, Ocean Life, Cinderella, Spellbound, Rainforest Explorer, Weather Science Explorer, Counting on Frank,* and *Reading Development 1 and 2.* The Living Books Series included *Mud Puddle, Heather Hits Her First Home Run, Just Grandma and Me,* and *Moving Gives Me a Stomach Ache.*

References Used in Preparing Technology Sessions

In preparation for the computer and technology-related sessions for mentors, the professor used various references as background information and as a guide to facilitate teacher-mentor learning. These references included Brown, Ann C., *Visual QuickStart Guide ClarisWorks 4 for Macintosh,* Peachpit Press, Berkeley, CA, 1996; Crabb, Don, *Guide to Macintosh System 7.5,* Hayden Books, Indianapolis, IN, 1994; Fraase, Michael, *The Mac Internet Tour Guide: Cruising the Internet the Easy Way,* Ventana Press, Chapel Hill, NC, 1993; Harris, Stuart and Kidder, Gayle, *Netscape Quick Tour for Macintosh, Accessing & Navigating the Internet's World Wide Web,* Special Edition, Ventana Press, Chapel Hill, NC, 1995; Holden, Greg and Webster, Tim, *Mastering Netscape 2.0 for Macintosh,* Hayden Books, Indianapolis, IN, 1995; Nelson, Kay Yarborough, *The Little System 7 Book,* Peachpit Press, Berkeley, CA, 1991; Schwartz, Steven A., *MacWorld ClarisWorks 4 Bible,* IDG Books Worldwide, Inc., Foster City, CA, 1995; Shankar, Gess, *Welcome to CD ROM,* Second Edition, MIS: Press, New York, 1996; and Williams, Robin, *The Mac is not a typewriter,* Peachpit Press, Berkeley, CA, 1996.

Issues/Dilemmas that Arose during the Professional Program

Although the majority of mentors were neophytes with the basic use of computer technology and computer software, a few mentors demonstrated extensive experience with some of the software programs. When teacher-mentors encountered a lesson familiar to them, they used the time to assist colleagues with computer technology and to develop their knowledge of programs less familiar to them, e.g., Internet. While the instructional pace was appropriate for the teacher-mentors, at times, a few mentors had difficulty with certain steps of the software programs. To handle this dilemma, colleagues assisted one another in a cooperative learning format, and a computer-literate person worked individually with mentors. While most teacher-mentors had accessibility to computers in their classrooms or schools in order to practice, a few did not. These mentors were invited to use the university computer lab or the computers in the university library to practice computer technology learned during the classes.

Implications of the Professional Program

The teacher-mentor professional program in technology served two major purposes: First, mentors developed a knowledge base of computer and related technologies to guide and assess beginning teachers' use of technology during instruction. They acquired familiarity with the technical terms of technology and the types of software programs and CD-ROMs available for instructional use.

Secondly, the professional program provided mentors' continuing education to assist them in meeting lifelong learning objectives as well as to provide opportunities for self-learning using technology. For many of the mentors this was the first professional development program in computer technology. This learning experience helped them "become

effective agents for their own lifelong learning and personal development," a process of self-discovery (Chickering, 1994, p. 3). Teachers became more intentional about their specific personal and professional needs. The professional program provided an opportunity for teachers to ask questions in a non-threatening atmosphere and to learn with and from colleagues. Mentors discussed common concerns about the availability of computers and related technologies, and their use in the instructional process. The ability to access and "surf" the Internet serves as a demonstrable example of the teacher-mentors' development of self-learning. Before and after the Internet session, participants would regularly search for pertinent information to accompany instructional materials, especially for thematic units. The ability to use E-mail provided one teacher-mentor the opportunity to communicate with her son stationed 1500 miles away at a military base. At the end of the program, each teacher-mentor presented a portfolio, which included weekly self-reflections, that documented their professional and personal growth.

Conclusion

The university's instructional and technical resources, and the process of collaboration between university faculty and teacher-mentors in determining educators' lifelong learning needs, precipitated a renaissance in adult learning (Cross, 1991). A joint educational responsibility exists in which higher education assists classroom practitioners with the knowledge and guidance in current technology for a changing world (Cross, 1995). And, in turn, the technology-proficient mentor-teachers assist beginning teachers as well as their own classroom students to prepare for a technology-driven environment, demonstrating a positive ripple effect in lifelong learning in preparation for the 21st Century.

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Training That Makes Teachers Technology Evangelists

Mary Jones
Fort Worth Independent School District

Marla Shelton
Fort Worth Independent School District

Fort Worth Independent School District's Instructional Technology Department can show you how to make your technology staff development training so effective that participants will get excited and spread the word. Your training will become so sought after that teachers will eagerly apply for the classes and routinely fill waiting lists hoping to get in. Just follow these simple steps based on three "I-" words: Incentives, Inventive, and Important.

Offer Incentives

Incentives can be big as in our Technology Bootcamp, TECHS Seminar or Teacher Technologist Institute where upon completion of training, teachers get a computer, printer, and software for their classrooms. Training programs for which teachers get a computer include a minimum of forty hours and are focused on teachers with specific skill levels. The following table provides additional information.

Table 1.
Technology Training Programs - Fort Worth ISD

Course and Selection Process	Hours	Skill Level using Technology	Incentive	Followup Requirement
Technology Bootcamp – Selected by committee from emailed applications	40	Novice	computer, printer, and software for the classroom	Contribute two class-tested technology-based lesson plans to our database during the next school year
TEC 21 Seminar – Selected by committee from free-form applications designed to highlight existing technology skills	40	Some experience	computer and software for their classroom	Develop and share a multimedia project which addresses a learning objective in their grade level or subject area
Teacher Technologist Institute – Selected by principal using guideline criteria	46	Some experience; word processing skills required	computer, printer, and software for their classroom	Donate 20 hours of technology training to teachers at their school and contribute one class-tested technology-based lesson plan to database

Incentives can be small. Our *Take the Class - Get the Software* sessions allow teachers to receive training and get software to use with their students the next day. For these classes, we select software for specific grade levels and subject areas that reinforces our district's objectives. To take the class, teachers must teach the appropriate level and have a computer in the classroom or regular access to a computer that will run the software. For example, if the software is specified for grades K-2, Macintosh format and comes on a CD, the teacher must teach one of those grades and have that type of computer with a CD-ROM drive to take the class. This method of training has placed a lot of good software into immediate use by our students and has given teachers another way to present or reinforce an objective.

Incentives can cost nothing at all. Valuable opportunities can be made available to your participants without additional cost. For example, training can be tailored to meet specific needs that teachers must address. In the fall of 1998, all Texas teachers must integrate the Texas Essential Knowledge and Skills (TEKS) into their curriculum. Some teachers would consider our class offering *Training and Lesson Plans for Integrating the TEKS for Technology into your K-5 Curriculum* vital without further incentive. Training can also address specific groups such as this class offering: *Using Technology to Address Learning Styles and Special Needs of Students in Alternative Schools*. If the teacher knows that the training will meet a particular or individual need, that is often incentive enough.

Be Inventive

Not all teachers will jump into technology use just because their students love it or because technology would make some things easier for them. Offering classes that use technology in unusual ways may be just the hook to reel in an otherwise reluctant teacher. We offer a whole series on *Technology and Textiles* with the hope that teachers who enjoy these classes will be encouraged to use technology in their instruction. The series includes computer quilt design, how to make cloth books, computer pattern customization, and computer conversion of scanned images to cross stitch designs. We even demonstrate the use of sewing machines with computer chips that will sew your computer-entered image. Along a similar line, we offer *T-Shirt Design and Print* where teachers use a computer to create a design, then use our commercial press to put it onto a T-shirt. That same press or our special laminator can create name badges. Mouse pads, refrigerator magnets, bound books, and much more can be computer-created and finished on our special equipment. Even our more conventional classes are focused on empowering students and teachers with technology, not just using technology. For example, a class concerning laserdiscs emphasizes repurposing the laserdisc to fit the

teacher's objectives rather than just how to use laserdisc technology.

Important Resource

Your trained teachers are *Important* to your training network. Value and support them as they use technology. The majority of teachers we train are asked to contribute something to our technology training program. For many teachers it is a technology-based lesson plan that is presented to other technology-using teachers at a meeting following their training. These lesson plans are added to a database that is given to all contributing teachers and made available to all district teachers through our preview lab. Other teachers contribute a multimedia project that is begun during their training and presented during the following semester. These projects are written to CD and made available as well. Some teachers contribute training for other teachers in trade for their specialized training.

Our most ardent technology evangelists volunteer for high-end training such as PhotoShop, Premiere, and video editing and become the district's training specialists for those applications.

Continued Support. Every teacher who takes our training is recognized and supported in some way. Trained teachers receive our newsletter which highlights teachers using technology, provides tips for computers, printers, operating systems, and some common software; announces contests, grant opportunities, and conferences, and includes a calendar of our scheduled training classes. The next step of training is offered regularly for teachers at all skill levels. *Bootcamp Booster* classes help beginners to take their skills to a higher level. Since both word processing and using a database are addressed in Technology Bootcamp, one Bootcamp Booster topic is *How to Do a Mail Merge* which uses both previous topics. Teacher Technologist Institute graduates can move to Teacher Technologist Level II and Teacher Technologist Level III by completing training requirements from previous levels and taking advanced training.

Stand-Alone Training. TECHS Seminar and *Take the Class - Get the Software* participants may take more stand-alone training in everything from *Scanners, Cameras, and Video Capture* to *Using Presentation Software*. The more technically oriented may take classes like *Operating a School BBS* and *Build Your Own Computer*. Of course, *Integrating the Internet Into Your Curriculum* is in demand right now as we finally have Internet access in all our school libraries. Teachers whose subject areas have electronic textbook adoptions receive training in using that special equipment and in teaching strategies that take advantage of the technology.

Recognize Achievement. We have an annual *Celebrate Teaching with Technology Teacher Awards Program* that spotlights exciting uses of technology in instruction. The prizes for this program were chosen by a committee of teachers to be sure that what we offered would be desired by the entrants. Of course, the top prize is a computer, printer, and software for the classroom. The first year of the program, wiring for a classroom Internet connection was also included in the top prize. There are winners in each contest category as well as an overall winner. Categories are divided by grade level so a Kindergarten teacher is not competing against a High School teacher.

Funding. The scope of training incentives we can offer is enhanced by the Texas Technology Allotment. Our school district receives funds from the state according to enrollment. This money may only be spent on hardware, software, and technology staff development.

Evangelistic Spirit. When all is said and done, teachers who take our training tend to spread the word. That's why we say our Technology Training Makes Teachers Technology Evangelists.

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The "Toolness" of Known-Anonymity in Teacher Education Through *FirstClass®* and Multi-Geographic Collaborative Learning Groups

Rich Rice
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When teaching strategies for classes with writing are reexamined through the methods and contexts of computer teach-nology strategies, *both* practices (re)become refreshingly effective. This student and teacher reflection on learning and practice promotes lifelong metacognition, offers educational empowerment, and enables reconciliation between content and method through building on the known and creating exciting avenues for the new.

Computer Assisted Teaching Strategies as High-Impact Classroom Strategies

Many secondary and post-secondary students are becoming quite familiar with the benefits of anonymity and the elimination of time and space when communicating through email for purposes outside academe. However, they may still struggle with fluency and voice in their "academic" writing. By reflecting on this medium's relationship to the writer, the text, and the audience—as a class—and by examining such related issues as fluency and voice by sending (virtual) email inside the classroom *without* computers (passing notes), the opportunity for students to empower their writing becomes immediately apparent. For example, ask each student in a class to write one sentence on a specific issue and pass it to another student in the class. The new recipient can then write an agreeing or rebutting position and either pass the note back to the originator (the known participant), or to a third person in the class. After a few iterations, ask students to reflect on the differences between responding to positions that agree and responding to positions that rebut the perspectives raised by known participants then, examine differences in responding to known participants versus responding to perspectives of the semi-anonymous (positions from unidentified students in the class). How do varying audiences effect the rhetorical stance of the writer and the text? How does the writer invent the audience or how does the audience invent the text (Ede & Lunsford, 1984)? Ask students to reflect on how it might be different to respond to perspectives of people who are "completely" anonymous (outside of the class). How does what's known about the writer shape the significance of the text or the audience's relation to the text? While these questions are not new, by metacognizing the electronic medium in terms of the paper-based model, by passing notes as virtual email, content learning is enhanced.

This same metacognitive reflection can be adapted to other activities in our classroom instruction. Is it possible, for instance, to simulate freewriting on a computer through paper-based methods? Perhaps not, but the attempt to do so will demonstrate the recursive nature of writing. Freewriting is a process-oriented approach to allow writers to engage in expression with as little critical mediation as possible. When freewriting with pen and paper, however, because most writers must look at their writing hand when composing, immediate visual and mental recursion takes place. Writers can think about and see what they are writing, as they write it (Perl, 1980). When typing on a computer, however, writers do not need to worry about penmanship and, if familiar with the keyboard, do not need to watch their hands or the screen. It would seem in this case that recursion exists solely in the mind (Berthoff, 1981). How does this different process of writing change the rhetorical triangle? Does the writer on the processor "embrace the typo" or does the practiced right-hand pinky of the typist instinctively reach for the Backspace-Key? Further, how do the sounds of the typewriter—or the imagined echoes of their plucking—effect one's writing? What about the sound of other keyboards flattering about in the classroom? Does the accelerated pace of familiar key combinations move freewriting in different directions? What about the need to save one's work? If a writer is comfortable with her handwriting will her fluency be more confident than a writer whose courier typeface is annoying? Does re-processing a draft on a computer or on hardcopy promote and lead to re-visioning or more product-based editing? Applicable inquiries on traditional teaching theory moves students to question their own process of writing. Reading

as well as writing and thinking develops into a truly interactive process. Students and teachers can energize traditional strategies of learning and teaching if the medium and content are reconciled, and if class inquiry is rooted in known practices.

"Known-Anonymity": The Known-New Contract in Synchronous Strategies

This reflective, known-new contract can be applied to collaborative, synchronous activities as well. Reflective learning involves being wholehearted to the project at hand, sincere and open-minded to each perspective, and responsible to the hidden curriculums or ideologies present (Woolfolk, 1995). A writer's voice becomes more wholehearted and sincere if her confidence isn't checked by an unfriendly conception of audience. It doesn't take long for teachers who use chat rooms on the Internet or synchronous communication programs to discover that student voice may be wholehearted and sincere in these environments but often lacks a sense of responsibility. The newly found freedom that this malleable audience and "flexible text" promotes can often be counter-productive (Zeitz, 1992). Students often move too quickly: not from the known to the new but from the known to the unimaginable. It seems that for the student, the unimaginable demands no responsibility. There are, however, methods of harnessing virtual anonymity which offer the *freedom effect* and encourage voice and fluency yet inherently demand responsibility. Simply put, writers who consistently interact with the same "anonymous" audience over a period of time are more apt to become reflective learners. Students realize how the unimaginable can possess an (implied) image, and begin to engage in "known-anonymity," the virtual (you) understood.

Teachers need to be taught and learn strategies which build on the known to get to the new. These strategies, however, must be rooted in the students' consciousness and embrace reflective lifelong learning that includes responsibility as well as wholeheartedness and sincerity. Exploring the use of electronic synchronous chat programs in multi-geographic collaborative learning groups can offer a metacognitive reflection model that makes use of known-anonymity to encourage such responsible learning habits. These strategies, when examined in terms of classroom-based practices, much like virtual email, (re)simulate for students and teachers responsibility in collaborative learning groups.

Known-Anonymity Through First Class Client and Other Environments

Modeling has often been viewed as the most effective teaching strategy that can be employed. Through modeling a successful synchronous chat with students inside the classroom, without computers, students are encouraged to participate in electronic chats much more reflectively. An asynchronous, synchronous chat *with* computers can also be modeled. For instance, ask students to write on a computer, switch seats, and continue the chat asynchronically. Further, reflecting on how students in a class come to know one another encourages the productive development of the unimagined to be known-anonymously (this encourages open-mindedness toward subcultures). That is, while there exists in electronic chat the opportunity to express ideas freely without some of the nonverbal intimidation that a walled classroom might hold, the community of learners in multi-geographic, synchronous communication strengthens each time these necessarily-responsible "anonymous" collaborators reconvene. Students build a sense of free-responsibility in their particular anonymous groups, responsibility that is intrinsically chosen and not demanded by a teacher. But why use collaborative groups with participants from other communities?

Multi-geographic conferencing does encourage open-mindedness and a sense of "respectable" responsibility. These chats, rooted in the interests of the students, also create natural bridges outside the academy which serve as models for classroom inquiry about community and subcultures. Students use their own experience as foundations to interact with the perspectives of others students. One ongoing set of courses can serve as a model.

What happens when a student from Oregon, a student from Indiana, and a student from New Hampshire regularly meet in synchronous chat as a peer-response group? While the students remain relatively anonymous to one another, the social distances between each student and their relative academic communities are (re)explored in terms of geographically-inspired distances between each student in the group. That is, because each student in the group has some reference to institutional marginality in common with each geographically-distant peer, the students discover this common link which bridges social and geographic distance. Further, differences between the teachers of these students and their discourse communities are (re)explored. This is the practical teaching of reflection rethinking.

As we strive to rethink technology in teaching from the less instrumental to the more substantive, *real* techniques on how to integrate technology into our teaching practices need to be examined. The theoretical hypothesis of the power of known-anonymity in electronic collaboration can be investigated through many different computer programs. One set of environments which has helped students discover the usefulness of peer-collaboration through known-anonymity includes the use of *FirstClass*® (*FC*) and a web-page learning system. *FC* is an Intranet Client that has been an environment that is easy to explain to distance learning students. *FC* offers our students seamless remote access to a series of user-friendly folders and conferences, electronic mail, and synchronous chat, all in one package. More information about this program can be found through

http://www.softarc.com. Although *FC* does incorporate web-pages, we've built a set outside *FC* at http://www.bsu.edu/classes/newbold/104. Known-anonymity has played a key role in the development and practice of this course.

Because many of our current students are from previous sections of computer assisted writing courses, and because this is distance learning, our students begin the course with some knowledge and experience of working in networked environments. A sense of community develops *within* groups and then *between* groups in *FC* and we ask them to share their work and their community with other students outside of class. We move from the known to the set of web-pages outside *FC*. These pages serve as jump-off points to other synchronous mediums such as LinguaMOO at http://lingua.utdallas.edu; to other Online Writing Labs such as Washington State University's http://owl.wsu.edu; and to other class web-page learning systems where students introduce themselves to students at programs from three different states.

Using *FC*, students in our distance learning sections begin their journey through our class folder (see fig. 1):

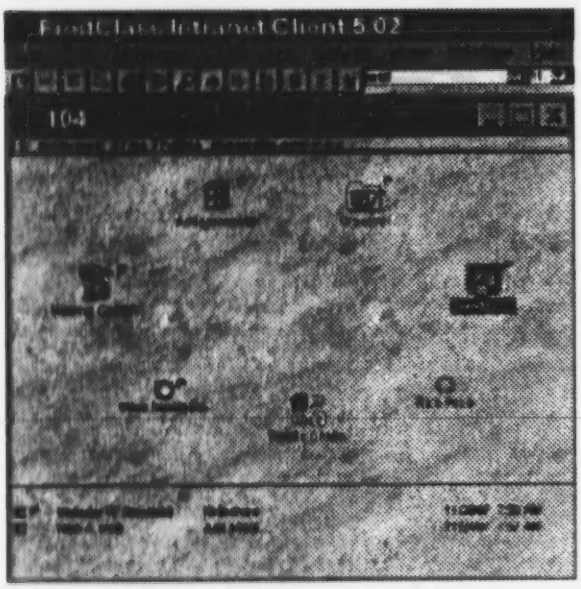

Figure 1. The Class Community

Informal writing assignments which require process-oriented, asynchronic dialogue with the class readings, as well as synchronic conferencing within each group, are offered each week. Formal writing projects which explore various student-centered themes in the course, such as "The Writing Process," "Time, Space, Relativity, and Reliability," and "Mirrors and Labyrinths," are also scheduled. A mailbox flag notifies each student their account has received new information to explore. Once the information has been reviewed and interacted with, the new information becomes the known.

Each group member shares the process of their thinking within their own group community and then offers to the other groups particular synchronous chats in the form of "Public Chats." Each group has their own set of folders to store their recorded chats, their peer responses, their essay drafts, and their dialogue journals. Each of these process-oriented tasks are reviewed by the instructors as well as each group member throughout the course (see fig. 2).

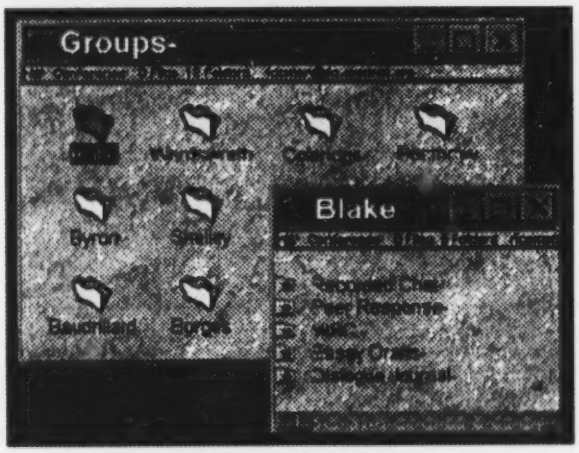

Figure 2. First Class Groups

Thus, a student has the opportunity to gain the confidence necessary to share his or her voice with others outside his or her immediate community through a series of known-new contracts. The reflective known-new contract is extended to the reflective known-anonymous contract through the class web-page learning system; carrying with it the hidden curriculum that responsibility as well as sincerity and wholeheartedness is a lifelong endeavor (see fig. 3). Through synchronous and asynchronous process-writing curriculums; teachers in Oregon, Indiana, and New Hampshire have pooled their learning communities together to foster a rich collaborative tool. Interacting courses do not necessarily have to be distance learning courses: while it is difficult, scheduling online conferencing between three different courses in three different states in three different time-zones can be done.

Perhaps the most effective teaching strategies are those which are useful tools *and* provoke a special kind of response from the faces of students: something that says "coolness." Exploring known-anonymity through *FC*, and reflectively extending this process to other communities through multi-geographic learning groups, has created an inhabitable hyperspace which has offered a shared sense of metacognitive "toolness." As teachers strive to make the "Information Age" the "Interactive Age," exploring such teaching and learning strategies as "known-anonymity" is

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not only useful to promote lifelong learning in the transitioning times we live in, it is absolutely necessary.

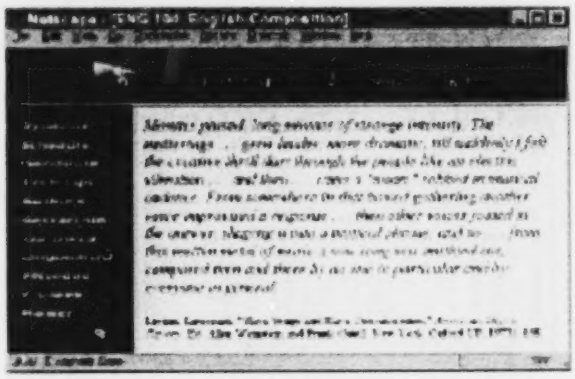

Figure 3. The Class Web-Page Learning System

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Early Literacy: The Empowerment of Technology, Global and Longitudinal Proof

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As literate adults we listen, speak, write, read and use technology to problem solve and accomplish the tasks of daily living. Schooling needs to be a mirror of the society a child will need to function in. Integrating reading, writing and spelling in the curriculum have been shown to be effective means to this goal. This paper will present two approaches to the integration of reading, writing, and spelling with technology for early literacy.

Research

Brain research (Sylwester, 1995) supports the finding that the brain learns holistically and in an integrated fashion. Isolated teaching that expects the learner to make the connections between various subject areas is complicating the task for the brain. The learner often does not see the connection between this type of learning and the real world in which they live. Through integrated reading and writing lessons and language experience activities aligned with science, social studies, math, and other subject areas, children learn that reading and writing are not just for learning how to read and write; they are for life (Jensen & Rosen, 1987). During the early years of schooling, both reading and writing serve a variety of child-generated pragmatic functions, ranging from letter and message writing to thank-you notes to list making, story making and research report writing. Clearly, the teaching of reading and writing must not be separated (Heller, 1991).

Simi Star Project

Children in six school districts, twenty-four classrooms, were presented with an integrated writing, reading and spelling program supported by the computer as a tool for producing their work. Evaluations of over 2,000 writings of these children showed that they were writing and reading two levels higher then their peers in classrooms without technology support (Casey, 1994). Five years later a visit was made to observe the students who had started with computers integrated into their classrooms. These students had access to networked computers in the classroom as a tool to write and problem solve for from kindergarten to sixth grade. What differences had this made in their learning? As sixth graders they had been winning the district writing contests every year, and they wrote research reports of high quality way beyond what would be expected for a twelve-year-old. They had formed a WorldWide Web club and were designing their own WEB pages. Most of them had global penpals they communicated with daily from the classroom. Several were involved in global on-line science projects. They used Powerpoint in creating their science and social studies reports as well as HyperStudio for designing multi-media presentations. Using the computer as a daily communication tool was as common to them as a pencil has been to past students.

In interviews, they reported that they had influenced their parents to purchase a home computer and gotten their parents on-line. They reported that they felt a part of the technological job force they would one day enter. Several of them had ideas for improved technology that they were e-mailing to Bill Gates at Microsoft; there seemed to be no limit to their enthusiasm and creativity using the technology. Most impressive was the way that various students used the computer to highlight their own personal strengths. Some were already fantastic graphic artists and electronic animators; others wrote the poems and stories that won the writing contests and still others were focused on global on-line communications and projects. The school WEB page was the pride of the entire class since all were involved in constantly adding videos, personal information and photos to keep it lively and up-to-date.

Writing to Read and Young Children

Writing to Read (WTR) is a early literacy program developed in the early 80's by Dr. John Henry Martin, an educator with 35 years experience in elementary education. Writing to Read 2000 has been helping kindergarten and first grade students across the nation write and read in their own natural language. As recently as 1988, over 1 million preschoolers, kindergartners, and first graders had already experienced WTR in over 5,000 labs and classrooms in schools throughout the U.S. (Grimm, 1988).

A vital component of the Writing to Read 2000, program is the creation of a literacy rich environment which provides numerous opportunities for writing, reading, speaking, and

listening. Using a multiple learning-center approach, the Writing to Read 2000 environment provides opportunities for the engagement of multiple modalities-visual, auditory, tactile and kinesthetic. The purpose of this program is to enable children to write and ready by using their own natural language. The major focus of the program is on children's daily writing of their experiences on the talking word processor, but at the same time computer software introduces the alphabetic principle, or the idea that the words of our language can be constructed with sounds, or phonemes, which are represented by letters or combinations of letters (Martin 1986).

Language Processing

Today with the sophisticated word processor replacing the pencil as the writing tool of choice, learners can put their own thoughts and ideas directly into the computer and see what they wrote, hear what they wrote and print out a professional copy of their words and ideas immediately for their enjoyment and to be read to all interested parties and as proof of their ongoing literacy development. I have called this new process of converting our language experience stories to print via word processing, Language Processing. Writing to Read 2000 and similar early literacy programs using technology and learning centers in the classroom can provide students with language processing support throughout the day in all curriculum areas. One hour a week visits to a computer lab are not sufficient to allow the power of this writing, learning tool to have any lasting effect on learners. This is a tool that must be as available as a pen or a pencil. Writing must be practiced daily in conjunction with reading good literature and classroom discussions and explorations of topics students need to know and are interested in learning.

Qualitative and quantitative evaluation of Writing to Read

In an effort to demonstrate to the educational community and test for themselves the effectiveness or lack of effectiveness of the Writing to Read program, six major California School districts joined in a partnership with IBM to get the computer equipment and then hired me as an outside educational consultant to write a detailed qualitative evaluation plan and then conduct a major two year evaluation study. Having done a significant qualitative evaluation of school reading programs for the ABC Unified school district in 1984 I had experience in this research methodology (Casey 1984). In fact the qualitative evaluation plan gave a much more accurate picture of what the innovation had accomplished. Over 1,000 writing portfolios were collected from K-1 students representing 29 classrooms in 6 school districts. Included in the population were several Spanish-language classrooms, ESL classrooms, and classrooms with learning handicapped students. All students in the experimental Writing to Read program averaged at least two writing levels higher than those in the control classrooms. The experimental group had a significantly higher positive reading attitude than the control group. Students identified as ESL, LD, ADD achieved the same benefits from the program as did the other students.

Riordan Foundation

In 1987, lawyer and philanthropist Richard Riordan visited a Writing to Read site and was impressed with the early literacy development of the young children he saw there accomplished through the use of technology. Convinced that early learning and early intervention was essential to bring literacy to all of the students of Los Angeles Riordan formed a foundation to help provide computer equipment to schools that were willing to pilot these new programs and provide training and implementation for their teachers. He was dedicated to giving all students this early literacy environment. The Los Angeles Roman Catholic Archdiocese was one of the first groups that Riordan made his generous offer too. The Los Angeles Archdiocese is the largest in the United States, both in terms of territory and population. It spans Santa Barbara, Ventura, and Los Angeles counties. Several of its schools contain large pockets of Hispanic and South East Asian ((Korean, Vietnamese, and Cambodian) cultural minorities. At first their response was rather cool, perhaps the sentiment being....."if God had wanted us to have computers, he would have mentioned it in the Bible." However they were all fine educators dedicated to the early learning of their students and willing to give it a try. Once their computers arrived in their schools and they had the opportunity to witness the empowerment of the young children they served, they rapidly became converts to this new technology. One of the very same sisters who reluctantly agreed to try the program in the beginning, when I phoned her a year later to find out the progress and ask if she would like to return the lab, she said, "absolutely not, why it is a miracle!"

Now nine years later 160 out of the 320 Archdiocese schools have computers in the classrooms. Sister Agnes Jean Vieno is the enthusiastic and capable Writing to Read Coordinator. She proudly told me, "all our children can write and read at five. Teachers see what happens when the children are interested, involved and empowered by the computer and get very excited. Success of the children makes believers of the teachers. Now the teachers from all the other grades want computers in their classrooms.

Sister Agnes Jean strongly believes that computer technology belongs in elementary schools. "We live in a technology-oriented age. Our society is permeated with computers," she says. "We're all turned on by media. It's natural for little kids to sit down without any fear at all in front of technological components of any kind, including computers, and go ahead and use them as tools. It would be a wasted opportunity if schools did not capitalize on the attraction youngsters feel for computers.

Unlike television or videocassette players there's something magical about computers suggests Sister Agnes Jean. To get a computer to work, you have to do more than simply turn it on. "With a computer you have functions to perform," she explains. "How you use those functions is going to change that piece of media. Either we teach our youngsters to use it well or we're cheating them. Children's ability to get and hold a job in the future is completely dependent upon whether they are computerize. "One of the most important results of the program," suggests Sister Agnes Jean, "is the aspect of self-image, the improvement in self-esteem that happens because little kids are largely able to manage a lot of their own learning.

Mary Odell is the director of the Riordan Foundation and she told me that they have been involved in state-wide implementations of Writing to Read in the states of Mississippi, Rhode Island, West Virginia, Alabama, and Vermont as well as the many California Schools. To date the Riordan Foundation has participated in funding approximately 1600 Writing to Read projects in 36 states. To those who comment that schools cannot afford this type program, she points out innovative educators like those in the state of Illinois who have found resources by decreasing the thousands of dollars previously used for large textbook buys and freeing up funds for technology. Children have been shown to be much more avid readers of the stories they have written and literature books they have selected then any basal stories.

Now fourteen years after the beginning of this technology innovation for early literacy, I attended a Focus meeting of the Riordan Foundation, formed eight years ago by the Mayor of Los Angeles, Richard Riordan, this foundation has given 8 million dollars to date to support technology for early literacy in our schools nationwide. I listen to the success stories from the Los Angeles Unified School District and wonder what it will take for us to finally give all our children this opportunity. The labs in L.A. Unified never sit empty, after school and on Saturdays, pre-schoolers and illiterate parents work as a team on joint family literacy projects.

When the leaders of school districts who had used this program for over eight years were asked to give their summary of the most powerful aspect of WTR, their first response was the self-esteem of the child and the belief or attitude that they can be a success at writing and reading, so important for any beginning learner. Next they mentioned that the computer whether in labs or in the classroom offered students the opportunity to be completely independent at manipulating and using the technology by themselves. They felt this independence and ability to create their own pace and literacy acquisition was a key to success.

Summary

Summarizing seventeen years of global research on the use of technology for early literacy, the proof is undeniable, using computers in the primary classrooms has been proven to have the following benefits:

* Provides students with tools to build bridges from the spoken to written languages
* Enables students to write what they can say and read what they have written
* Utilizes the students' natural language base
* Uses integrated multi-sensory instructional methods
* Teaches students to be responsible for their own learning
* Takes advantage of advances in computer technology
* Technology has been shown to have an enormous positive effect on early literacy development for the children of the world, all of our classrooms now need to be equipped to support their learning.

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KEEPING TEACHERS CURRENT ON TECHNOLOGY

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There has been a tremendous increase in the use of technology in today's classroom. With major technological changes occurring at unprecedented rates, it is often difficult for teachers and educators to remain current on software and hardware advances. As software and hardware vendors compete for market share leads and innovation, and as the technological advances continue, the gap between the use of technology and the teacher increases. Everyday teachers are already bombarded with school, district, state, and federal mandates, it is now become almost impossible to keep educators abreast of such changes. Solutions to this ever-evolving problem must be provided and applied to our current situation.

During teacher education programs pre-service teachers are trained in uses of technology, application of various software programs, and taught ways to involve computing power into their classrooms. This little time spent during pre-service programs by no means presents a thorough training of the array of applications found in the classroom. In addition, by the time a student finishes his/her program, the technology has changed. These rapid revisions never give new teachers the opportunity to stay current with the most recent innovations.

Due to the numerous responsibilities a school-teacher must perform, in addition to rapid technological changes, current educators find it difficult to keep current on the most recent advances in educational technology. In-service training programs are trying to combat such occurrences, but have to balances other district needs, financial considerations, and various state stipulations. These issues are addressed by the poster session presented at the 1998 Society for Information Technology and Teacher Education (SITE) conference in Washington, D.C.

Issues of focus for the poster session include providing approaches to solve two major issues: (1) how to keep teachers current with today's technological advances, and (2) identifying what types in-service programs school districts can perform to keep their teachers on the cutting edge of technology.

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INSTRUCTIONAL DESIGN

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Technology is continuing to develop at an accelerated rate, bringing new opportunities for teacher educators to share new skills and information. As the field of instructional technology develops, the need for strong instructional design increases. Instructional design is a process in which instructional problems are addressed by a systematic analysis of the conditions needed for learning. Though many design models exist, twelve authors impart their perspectives and address these design aspects as they impact their educational experiences.

Ahern, Mize, and Burleson begins this section discussing issues in design regarding the implementation of technology in today's classroom. They address the need for task and technology matching while focusing on factors in design.

This section progresses with Jin and Willis' article which focuses on the creation of an instructional package. Their package uses technology to introduce pre-service and in-service teachers to theory, practical teaching and learning implications of constructivism. The creation of their web site, The Constructivist Educator's Page, was developed using the Recursive, Reflective, Design, and Development instructional design model. This model is the scheme that guides their process of design and development while meeting their educational goal.

Lohr's article addresses an alternative instructional model, the ADDIE model. She uses this model in the implementation of her Web-based instruction. In her paper, she challenges instructional designers with the dual task of designing good instruction while providing clear directions for access and use of information.

The fourth article is Comer and Geissler's. In their paper, they propose a methodology for evaluating instructional software. This method is designed to acquire software effectiveness in the classroom setting. Comer and Geissler's writing also address issues a novice evaluator may need to consider when evaluating software applications.

Abramson's paper continues with evaluation by addressing computer-supported learning. This process involved a study which was used to learn about the various elements that contribute to successful, computer-supported learning. Abramson also identifies recommendations from home-users and teachers in the conclusion of her article.

Schoeny and Strang follow by using LearningLinks for the construction and evaluation of content modules in teaching. Their program is designed to provide guidance to users while they construct self-directed learning modules. LearningLinks is demonstrated as a well suited application for achieving outcomes such as learning definitions, spatial orientations, and interrelationships between content elements. Faculty at other postsecondary institutions are invited to cooperate.

Carlson's article moves from evaluation to addressing courseware. In her paper, she reflects on her own experiences in the development of two courseware projects. Even though her projects were not modeled after one other, both used a holistic design paradigm. Carlson identifies the effects of this holistic design, discusses the classroom assessment and teacher input aspect of the development process. Her article concludes by stressing the critical role played by formative evaluation in the development process.

The next article in this section addresses the development and utilization of software to analyze teaching performance. In their article, Stranbrough and Stinson, show how software programs can be used to facilitate the collection, analysis, and reporting of observable teaching behaviors. Their program, called The Evaluator, is based on researched teaching behaviors which have been shown to influence student learning. Effectiveness of the reports generated by The Evaluator may lead to positive behavior changes in classroom teachers.

Jackson and Brent address, POLIS, a web course construction kit in their article. They discuss POLIS in terms of attempting to meet the demands of faculty and administrators who want innovative instructional support tools. In their article, they identify the major purpose of

this developmental software for building teaching materials as well as for the dissemination of information over the World Wide Web. Jackson and Brent emphasize the need for making this process as easy as possible.

The next paper moves to a case study approach where the authors, Graves, Barnett, Gamble, and Kolak present the use of this forum to teach about instruction design. In particular, they focus on addressing the needs of a teacher education program at the University of Houston. Their case study involves implementation of instructional design into teachers education at the graduate level.

Gibson, Sebastian, Herber, and Mayhew, in response to the needs of American Indian students of Utah, designed a group of collaborative multimedia courses. They identify the need of these courses as a way to prepare teachers to work more effectively with American Indian students. The development of these courses as well as the theory used to design these courses are identified in their writing.

This section concludes with Last, O'Donnell, and Kelly exploring the influences of student's prior knowledge and desired goals on the benefits and dilemmas while using hypertext. The authors used student interviews to understand and examine the pathway taken through a hypertext system. The experiences of the authors in this section will help the development of instruction across many areas of teacher education.

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EMERGING TECHNOLOGY FACTORS IN DESIGN

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Current computer technology has given us faster machines with more raw power than was imaginable just five years ago. It has been said most computers have a half-life of about 3 months. As soon as you purchase the equipment the new models are starting to roll down the assembly line. Given such a rate of change, educational computing is struggling to keep up. This is not a new problem as Taylor wrote in 1980 that "the application of computing to education encompasses a range of complex activity, formidable in its apparent diversity" (p. 2) and can be confusing for even sophisticated users of computer technology. His observation is even truer today.

Schools are pressured to use not only the more traditional technology but to embrace the more exotic of the new communication tools such as the Internet and the World Wide Web (WWW). Schools are expected to purchase the latest and greatest technological marvels for the classroom. Teachers are also faced with enormous pressures to implement technology, which according to the media and pundits, will revolutionize teaching and learning. The major problem for teachers besides access is how to effectively choose from a myriad of innovations which one is most appropriate given the instructional task.

Teachers are caught between two views of technology. The transparent view, in large part championed by Clark sees the instructional outcome as paramount. According to Clark (1983) the technology used to reach the goal is unimportant as long as the goal is reached. Consider fixing a loose bolt. The goal is to tighten the nut which can be accomplished with a variety of tools: a pliers, an open-end wrench, a socket wrench etc. If we tighten the nut, then it really does not matter which tool was used as long as the goal was accomplished. Technology is only a means to an end. If the technology works it becomes transparent to the user as a result.

The revolutionary view, in contrast sees technology as an end in itself. In this view the technology revolutionizes the way we do things such as how we teach, learn, interact etc. These powerful technologies by themselves are able to transform schools instantly not only in how teachers teach but also in how students learn.

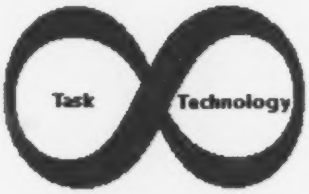
Technology is not transparent nor is it all powerful. There is a reciprocal relationship between the user and the tool. If a pliers was always the best way to tighten a loose nut, there would be no reason to invent a socket or adjustable wrench. In the same way technology is not revolutionary but evolutionary. The favorite example is the printing press that is touted as revolutionizing the printed word. On closer scrutiny this just not the case. It took over 200 hundred years to evolve what we have come to understand as the book. The older technologies of the script and pen were still utilized. In fact, even today, we still teach handwriting as not only a worthwhile but as an essential skill to know

The problem with either these approaches stems from a lack of understanding of the nature and use of technology. According to Simon (1996), the goal is not simply to accomplish the task but to seek the most optimal solution. If we could, we would make our tools fit precisely each task thereby maximizing the possibility of an optimal solution. Given the real world, however we settle for something less than the optimal which Simon calls satisficing. For example, a pliers is not a very good choice for tightening a loose nut; a better choice would be an adjustable wrench. An even better choice would be an open-head wrench and finally the best choice, given the nature of the task, would be a boxend or socket wrench. If we do not possess or have available the correct wrench, we will satisfice by using the pliers to do the job. If the technology is truly transparent or revolutionary, then there would be no reason to improve or invent new and more effective technologies.

These view of technology demand that our teachers always satisfice. First by contending that technology is transparent and it does not really matter which technology you use. Secondly, the revolutionary approach says that old technology is irrelevant and that teachers will always need the newest technology to be effective. What we need is a different approach that attempts to match the inherent characteristics of technologies with the inherent demands of the task.

Mize (1996) considers the underlying argument between task and technology as unified and reciprocal. Educators can begin with either the task or with the technology and arrive at the goal of improved instruction. A variety of tasks can be accomplished with a variety of

different technologies, because they are intertwined in such away that any change in either will require re-evaluation of the other. This linked relationship allows educators to begin with either the task or with the technology and arrive at the goal of improved instruction. For example a teacher may find a new computer in the classroom who can start with this one machine and discover what it can do. In contrast, another teacher may have an insight concerning an instructional task and then seek out help in applying the appropriate technology. With the infinity model (Figure 1) teachers can start improving instruction from either perspective because of the reciprocal nature of task to technology.



Infinity model

Figure 1. Infinity Model (Mize, 1996).

The infinity model allows teachers to start where they are comfortable. To effectively implement the Infinity model teachers need a filter mechanism (Figure 2) that will help them match the best technology for a given instructional task.

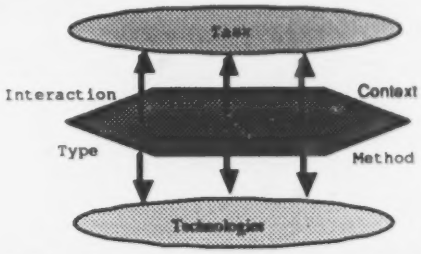


Figure 2. Factors Mediating the Task to Technology Fit.

In this way a teacher can create an optimal design for the delivery of instruction.

Factors in design

There are six factors (Figure 3) that influence the design and the delivery of instruction: time, context, interaction, task type, content, teaching method. Each of these factors is highly interrelated so that making adjustments in one factor will have a profound impact on many of the others.

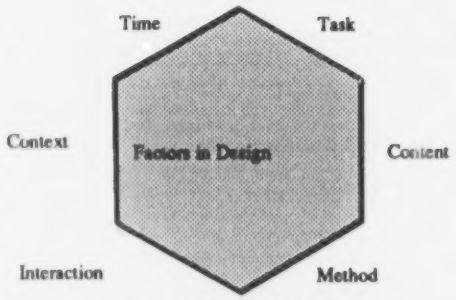


Figure 3: Factors in Design.

Time is a very important factor because it not only determines how much contact the students will have with the knowledge or skill, but it greatly impacts the design of the instruction. For a designer a 14-week course provides an opportunity to either delve deep into a particular topic or to provide the learners with sufficient breath. In contrast a 3-hour lecture poses problems for the designer.

Context determines the environmental channel in which instruction will take place, ranging from the classroom to a course delivered over the Internet. The context also indicates the available or necessary resources in order to deliver the instruction.

The interaction factor describes how the students and instructor will interact not only with the material but also with each other. This factor describes the style of the interaction. A teacher giving a lecture is a one-to-many style of discourse. There are other forms such as many-to-many in case of a small group discussion or focus group. The factor of task defines the nature of the instructional problem. Essentially there are two kinds of tasks, well defined and ill defined.

Well defined. Well-defined tasks usually have a clearly understood solution or can be solved through a systematic process of problem decomposition to axiomatic propositions. For example, finding the name of the city where the capitol is located for each of the 50 states is well defined task, which has a single solution. This type of outcome is well suited for novices and factual information, which can be presented directly and is easily acquired.

Ill-defined. In contrast an ill-defined task does not have an axiomatic solution. An ill-defined goal state is equivocal and normally requires multiple input that can lead to different solutions as well as perspectives. For example, trying to understand the reason that Lee lost at Gettysburg is ill-defined, because there is no one single answer. There are a lot of factors, input and different perspectives that provide a range of solutions.

Content is the state of the knowledge or the skill to be delivered in the instruction. Content can be dynamic such as HTML script, which is currently rapidly changing. Whereas high school physics is relatively static and has not changed much over the last 20 years.

The final factor is the selection of a teaching strategy, behavioral, cognitive or social. The interesting facet of this element of the design phase is that it is a dynamic process. If a designer is given a particular content, they must analyze the content and determine the best environment, the type of interaction, how much time and so on. Each step is intertwined with every other step.

Each of the six factors discussed above will impact the decisions of an instructional designer and one change in one factor will influence the other five factors. Consider a classroom teacher who is doing a lesson that is typically well defined. However she wants to instill in her students more creativity so decides to do more ill-defined problems. The research indicates that collaborative interaction, or teams will do better on ill-defined type problems. Consequently it takes more time to do group interaction. In addition, the teaching model requires a more social approach.

The instructional designer must consider each factor and how that factor influences the entirety of the design. The goal is to achieve a balance between each of the factors in achieving the optimal design. In this way we will have effective and appropriate instruction.

An Example

Using the factors for design allows teachers to integrate technology from whatever perspective that makes them comfortable. Remember our classroom teachers who want to instill more creativity into her students. At that time we did not even consider any technology. Given that she wants her students to engage in more collaborative problem solving technology could have an appropriate place. A simple place to start would be to have the student's pair up around a single computer and run a simple spreadsheet and then discuss the results with their partner. This does not require much in the way of altering the way the teacher typically did things, but notice it does require consideration of the environmental context in which she would conduct her class.

However, our teacher finds out about the Internet and wants to improve her lesson using the Internet. She wants to create an opportunity to make homework more collaborative and effective by creating a peer-to-peer problem solving system.

By first understanding the factors that constrain her from reaching her instructional goal she is in a much better position to choose the best technology. Time for this teacher is really not much of an issue because her goal permeates the entire course. Interaction, however, does play a central role in this design because the teacher wants a high level of peer-to-peer interaction. This is necessary because she has created a task type that is ill defined. The high level of interaction is necessary because all of the information necessary to solve the problem is not contained within the problem statement. The lesson content is fairly stable and is not undergoing any radical transformation. Finally the teaching method is transformed from direct instruction to a more social or discovery model in which the students must decide together what the best course of action will be.

Integrating technology into such a lesson requires a similar type of evaluation to choose an appropriate delivery media. Desktop video (DTV) appears to be a good choice because an ill-defined problem requires a high amount of interaction and collaboration. With (DTV) the students can see each other and interact in real time. Currently, most teachers around the country probably do not have access to DTV. Consequently, our teacher would have to redesign her task to fit the available technology. However, given our framework, the teacher is able to select a more appropriate and effective delivery media, abet somewhat less exotic. Looking at our task and matching the technology to the task, e-mail appears to be a better choice.

The teacher probably has access to e-mail. E-mail's characteristics provide for one-to-one interaction, asynchronous connectivity, a static artifact and a private social structure. Connectivity is easier. The students can log on whenever it is convenient, and it provides for peer-to-peer interaction and support. Further, e-mail is a text based medium, so that the artifact of the previous interactions are available. Students could review the various discussions in time for a test or exam. By understanding the task characteristics the teacher can create an optimal match with the appropriate technology.

Discussion

A variety of implications result from using the six factors as a filtering mechanism for instructional technology. The first implication is old technology can provide an optimal solution. Further, teachers are not limited by the technology or by what they are required to teach. What remains constant is the design. Finally teachers will no longer have to abdicate their responsibility in using technology. Technology is not inevitable but is due to the quest for an optimal solution to a particular problem. By exploring and maybe even designing better software, teachers can create the optimal instructional solution thereby providing an effective and appropriate instructional experience.

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A Web-based Instructional Resource for Teacher Education: Constructivist Approach

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Over the past ten years, there has been dramatically increasing interest in the use of technology to support student-centered/constructivist learning. However, in spite of the great benefits of technology for constructivist learning, the majority of teachers have little or no experience using technology in the classroom. That applies to constructivist as well as more traditional uses of technology. The problem appears to begin with the preparation teachers receive in their preservice programs. A number of recent studies and reports in the area of technology and teacher education (Willis & Mehlinger, 1996; OTA, 1995; Thompson & Schmidt, 1994) have indicated that preservice teacher education has failed to prepare teachers adequately. Even the teaching materials used in preservice teacher education have been questioned. Several reviews of instructional materials used for computing courses in teacher education programs have indicated that the content or structure of textbooks or instructional packages is inadequate (Padron, 1992). In fact, the lack of well designed, appropriate instructional materials that support the integration of technology into teacher education may be one of the major barriers to wider, more effective integration.

Writing a "better" textbook on the constructive use of technology is one way to address the problem of instructional resources. Another way would be to take advantage of the available technology and create an electronic resource. The work reported here focused on the creation of an Internet-based resource for preservice and inservice teachers. In this study a web-based instructional resource was developed by a participatory team comprised of subject area and instructional design experts as well as potential users including preservice and inservice teachers. The Recursive, Reflective, Design, and Development (R2D2) instructional design model developed by Willis (1995) guided the design and development process.

Product Overview

The Constructivist Educator's Page is a web page temporarily located at http://www.cite.uh.edu/seung/frame.html. It includes three general types of material: a database of information and resources, an area for discussion, and a collaborative project area. The entire site, including the home page, uses two different frames: a small left frame for main buttons which can be clicked to jump wherever the user wants to go in the site and a larger right frame that displays material selected by the users (see Figure 1). The database area, which is the largest area on the site, includes four units: i) constructivist learning theory, ii) lesson ideas, iii) cases, and iv) references. The discussion area allows users to select a thread by clicking a topic in the content frame. The project area provides annotated links to some ongoing projects as well as centers around the world where constructivist teaching is a major focus. Each area in the site contains a different type of information about constructivist teaching and learning. This web site is open to everyone who has access to the Internet.

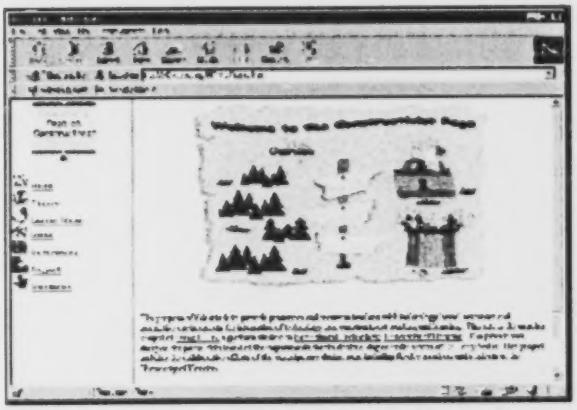

Figure 1. Home page on Constructivist Teaching

The Design and Development Process

The instructional design model used in this study, R2D2, is based on three guiding concepts: participatory

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design, recursive or iterative design, and reflection. Each of these foundational concepts supports the idea of gradually shaping a vague idea into a more precise and more fully formed product. The entire design and development process was iterative and occurred in a non-linear fashion. There was no linear set of steps, but it does include two focal points: a) the definition focus, and b) the design and development focus.

The Definition Focus

The definition focus included 1) front-end analysis that investigates whether there is a need for the type of alternative instructional material, 2) the creation of a participatory team that includes both experts and potential users, and 3) establishment of a progressive problem-solution focus that begins with a vague idea of what is to be developed and progresses through more and more detailed and complete versions of the material.

Front-end Analysis. The front-end analysis was conducted via a review of the literature on technology and teacher education programs, interviews with teacher educators and teacher education students, and observations of courses about technology in teacher education programs. Through the front-end analysis, several problems in technology and teacher education programs were identified: 1) Instructional strategies in teacher education programs are heavily based on behaviorist approaches. 2) Preservice teacher education students do not see modeled, or learn to use, a wide range of instructional strategies that support incorporating technology into classroom teaching. 3) While teacher educators and preservice teacher education students have positive attitudes toward constructivist approaches, instructional materials based on constructivist approach are not widely available. These findings formed part of the basis for creating the prototype of the instructional material developed in this study.

Creation of the Participatory Team. In this study the development team consisted of several teacher educators who teach methods courses for preservice teacher education students, educators who are knowledgeable about constructivist uses of technology, instructional design specialists, and instructors and students in preservice and inservice educational computing courses. The members of the development team helped develop the concept for the instructional resource, participated in the development of the prototype, and provided input and feedback on everything from instructional goals and topics to be covered to instructional strategies and user interface.

Progressive Problem-Solving Focus. In the R2D2 instructional development model both the problem and the solution are progressively defined throughout the interaction of the development team members. This study used several techniques such as semi-structured interviews, individual and small group tryouts, observations, and open-ended questionnaires to encourage participation in the development process. Subgroups of the team also occasionally met together to discuss the current status of the project and make decisions about changes.

The Design and Development Focus

The design and development processes were combined into one focus instead of separating design from development and requiring a linear "design first" "then develop" sequence. That is, members of the team worked on components of, and versions of, the package and made changes continuously. Some ideas were selected and developed across the process, but some were initially selected but later abandoned as the team elected to take the development in a different direction.

Preparation Tasks. The preparation tasks included a) selection of a development environment, b) selection of the instructional media, and c) selection of the format and instructional strategies. The preparation tasks were performed by discussion with experts and examination of contexts in teacher education programs.

a) Selection of a Development Environment - The development environment for this project includes a number of different software products such as Adobe PhotoShop, Microsoft Image Composer, and PowerPoint but was centered on the creation of a multimedia/ hypermedia Web document. Most pages in the site were created in Microsoft FrontPage and modified by hand coding.

b) Media Selection - The medium of instruction was interactive, Internet-based, hypermedia using World Wide Web (WWW) technology. The WWW is a powerful navigational tool, providing access to virtually limitless Internet resources. The instructional material developed on the Center for Information Technology in Education (CITE) server at the University of Houston was delivered via the Internet.

c) Format and Instructional Strategies Selection - The material developed in the study was created in a number of different formats, such as hypertext documents, instead of a traditional textbook format. Different units had different formats, called for different types of interaction on the part of students, and supported different types content. For example, the discussion area supported a range of communication alternatives. These alternatives included threaded discussion groups where topics can be raised by any participant (see Figure 2).

Creation Tasks. The creation tasks category includes the procedures for developing the product. These procedures of design and development were divided into five major types: a) beginning concepts and ideas, b) component development, c) single path prototype, d) alpha version, and e) beta version. Progress through these creation tasks was not, however, strictly linear. Some component creation was the beginning point, but components were revised, changed, or redone throughout the

process as the participatory team worked on improving the product. Throughout the process, feedback and participation from both experts and potential end users provided information used by the designer to make changes and revisions to the product.

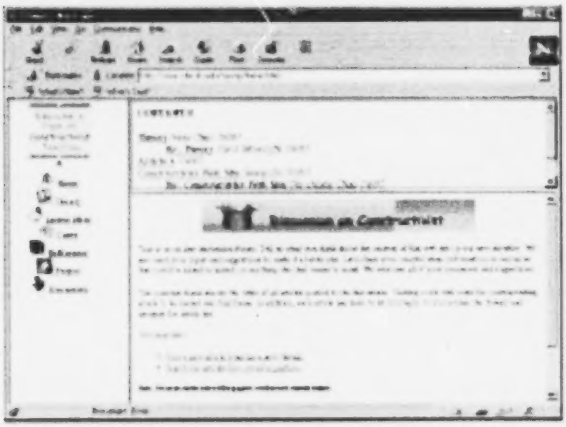

Figure 2. Interactive Discussion Area.

a) Beginning Concepts and Ideas - The beginning work started with the general idea of developing a web site that was an organized, but non-linear information resource on constructivist learning environments. Some of this content would be original, created specifically for the site, and some would be available via links to other sites. The conceptual outline of this web site was developed through semi-structured interviews with stakeholders like the instructor who had suggested the creation of this project. Interviews with four stakeholders were conducted to identify the needs of users. They suggested that effective materials for teacher education are needed to provide more information about instructional strategies based on constructivist approaches and various uses of technology in constructivist learning environments.

b) Creation of Components - During the design and development process for individual components, the home page was much more carefully developed than many other pages because the components of other pages in the site depended on the home page. After the home page was developed, a graphic design expert suggested that a consistent, integrative design relating the major units of the web site to the icons on the home page would help users identify their position while navigating the information resources. Most titles on the site were created in tones of green or yellow to make them consistent with the "Forest" icons that were used as a metaphor of the site's information landscape home page. In addition, one important goal of the design and development process was the creation of a user-friendly interface that would make it easy for novice teachers to navigate the web site.

c) Single Path Prototype - A single path prototype is a limited version of the product that allows users to explore all major aspects of the package if they "stay on one path." The purpose of creating a single path prototype was to obtain feedback or suggestions about all aspects of a working model before the development team created a version of the entire program. Eight stakeholders, two graduate students in instructional technology, three undergraduate students in teacher education, and three experts in instructional technology and constructivist learning theory, were involved in the evaluation of the single path prototype. This single path prototype was revised many times.

There were several major recommendations about the single path prototype from experts and students. For example, the theory unit was well organized with the emphasis on constructivist theory related to classroom teaching and some of the more esoteric links to constructivist philosophy were eliminated. In addition, all the links to other web sites were annotated with a brief explanation of the link (see Figure 3).

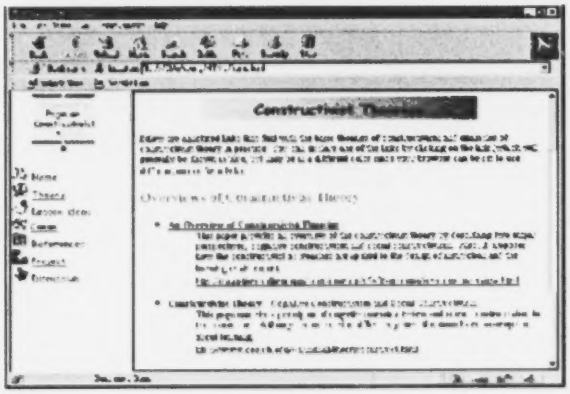

Figure 3. Constructivist Learning Theory Page in a Revision.

Experts and students who worked through the single path prototype were very positive about the site. According to them, the graphics were attractive and the layout was very clean and consistent. Also, they felt the content on the web site helped teachers understand constructivist theory and teaching.

d) Alpha Versions - When revisions in the single path prototype warranted no more significant changes, the alpha version, a full rough version of the product, was developed. The alpha version included all paths and options in the three areas of the site: database, discussion, and project. All components in the product were essentially functional though some areas still had rough graphics and tentative content. The alpha version was evaluated by experts and potential end-users including novice users who were not familiar with the content or web technology.

Three subject matter experts and five preservice teacher education students explored and evaluated all areas of the Constructivist Educator's Page. They were generally very positive about the overall content, data structure and user interface. Experts also made many suggestions about other resources that could be added to the site, including links to other web sites that described constructivist projects. Expert comments resulted in two major changes to the alpha version. The first major change was related to the content included in the lesson ideas area. In a revision several additional types of instructional strategies/learning environments were added including information banks, symbol pads, construction kits, phenomenaria, task managers, and microworlds (see Figure 4).

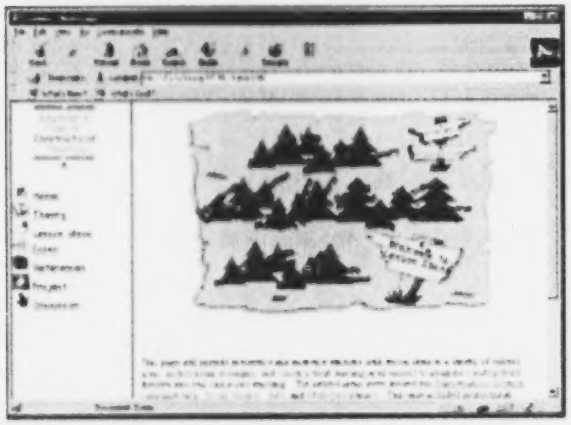

Figure 4. Lesson Ideas Area in the Alpha Version.

The second major revision was also related to paths through the database. One constructivist teacher educator suggested that instructional strategies and learning environments might be combined in one path and that another path for exploring lesson ideas by grade level should be added. Therefore the lesson ideas area (see Figure 4) was divided into three different paths: grade levels, learning environments or instructional strategies, and subject areas. A number of students who evaluated the alpha version also contributed lesson plans or ideas of their own. For example, the lesson idea called the Best Building was contributed by a student who was a second grade teacher in a bilingual classroom.

e) Beta Versions – When suggestions for revisions to the alpha version were made, the resulting the beta version was uploaded to the Center for Information Technology in Education (CITE) server at the University of Houston and was delivered via the Internet. Until that point components and versions of the material had been run locally from a Zip disk or hard drive. Users could access the Constructivist Educator's Page at http://www.cite.uh.edu/seung/frame.html. All components in the beta version were fully functional and all graphic design components were finished (tentatively). The beta version was evaluated by eight potential end-users through a survey questionnaire, by observations of use, and by informal interviews while students were using the product. Most evaluators felt the Constructivist Educator's Page was interesting and motivating. They liked the screen design including the use of color and text, and they found the navigation options easy to use and functional. They could navigate without any difficulty in the database area and project area.

There were a few suggestions for changes or revisions. For example, some users wanted to see more examples in their particular areas. Another comment was about background color. Two users suggested using a different, distinctive background color for each page, but this suggestion was not implemented. When asked, several other students said they did not want the color or background graphics to change from page to page because of additional time required to navigate the site. When all the revisions to the beta version were made, the product was considered to be Version 1.0. The Constructivist Educator's Page was then ready for general use in preservice and inservice teacher education.

Discussion and Conclusions

This study was a development project that used an alternative instructional methodology. While traditional studies emphasize objective methods of data collection, this study depended on subjective data obtained via interviews, discussions, observations, and questionnaires. The design and development work was performed in a flexible, iterative format that encouraged input from a range of stakeholders. Most decisions were made through negotiation among members in the collaborative group. Across the design and development process there were hundreds of revisions, some large, some small, but all a result of input from experts or end users.

Based on the comments of experts and end users, the Constructivist Educator's Page seems to have several advantages over traditional instructional materials. One of the advantages is that it supports a user-centered learning environment through a non-linear information landscape. Second, the web site is not a static entity. This web site can be a dynamic, changing entity in ways that are simply not possible with traditional printed material. Third, the Constructivist Educator's Page provides preservice and inservice teachers with not only a variety of lesson ideas but also accessible information on the basic concepts of constructivist learning theory. The Constructivist Educator's Page includes practical and useful resources relevant to constructivist teaching on one web site as well as links to many other useful sites. Fourth, with Internet connectivity, the Constructivist Educator's Page can be

accessed from anywhere there is an Internet connection by anyone who has access to relatively basic computer equipment, an Internet connection, and suitable browser software. There is no additional cost to access the resource. At the end of study, the Constructivist Educator's Page was judged by experts and potential end-users to be a valuable and useful site for educators seeking information on both the theories of constructivism and the practical professional implications of the theory. However, this ongoing project will be expanded and revised continuously through the active participation of preservice and inservice teachers.

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Using ADDIE to Design a Web-Based Training Interface

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Creating instruction for the World Wide Web is a complex task requiring multiple levels of design effort and skill. Accustomed to traditional face-to-face instruction, many learner's struggle in training settings like the Web which require self-direction. Since teachers are not readily available to answer questions as they arise, learners in Web environments often need an additional layer of instruction: instruction on how to take part in instruction. The instructional designer is challenged with the dual task of designing good instruction *and* clear directions for accessing and using the instruction.

The phenomenon of distance between the teacher and the learner in Web-learning environments requires optimizing a learner's sense of autonomy (Moore and Kearsley, 1996). Where in the past designers focused on designer-controlled events (the pursuit of the perfect mix of objectives and strategies for the maximum number of learners), designers in Web-environments focus on creating learner-controlled events (embedding strategies to increase the self-direction of the learner.)

While most instructional designers have considerable skill and experience in designing content, few have experience in designing optimal learner-control environments. The designer must create obvious ways for learners to interact with training by chunking content into menu/sub-menu structures, providing navigation tools, embedding instructions on how to go about learning in a Web-environment, designing feedback mechanisms such as LISTSERVS and Web chat rooms, to name a few. In short, the designer must proactively address many of the tasks innately performed by a teacher.

Criteria for designing learner-control are not well-defined and many instructional designers lack confidence when confronted with the task; in large part because few designers have the knowledge, skills, or experience in the design of graphical user interfaces (GUI.) A graphical user interface is defined as the form of communication between users and computers that facilitates interaction (Mok, 1997). GUI for Web-based training encompasses all interactions between a learner and the Web-based learning environment. Design for Web-based GUI includes creating all of the visual elements on the Web-based computer screen that help learners perform the task of learning.

Designing a Web-based GUI is a daunting task. Limited screen real-estate (space for communication,) the "lost in space" phenomenon of hypertext (Jonnasen, 1991), anticipation all of the design and technical problems learners can encounter in a virtual classroom (receiving instructions, motivation, participation issues, etc.), are just some of the challenges of Web-based design. As stated above, to accommodate these issues requires the designer to embed many of the functions of a teacher into the interface.

Modeling the functions of a teacher in a computer interface is not a new practice. Most computer applications today employ electronic performance support systems (EPSS) such as online help, wizards, coaches, and even some forms of artificial intelligence (such as Microsoft's personal assistant feature) that perform many of the functions of a teacher. The design and development skills required to produce EPSS fall into many domains outside education. Skills in graphic design, message design, human factors, advertising, cognitive engineering, and computer science are just some of the disciplines involved in the development of EPSS. Rarely is one person, or disciplinary field, skilled in all areas of design required (Mok, 1997). Until EPSS development tools are easier for the typical instructional designer to manipulate and use, embedding teacher functions into a learning environment will need to take a less sophisticated form. This paper presents easy-to-implement strategies for increasing learner autonomy by embedding teacher functions within the graphical user interface.

The embedded teacher (ET) model proposed in this paper is similar to the butler model (Hoekema, 1984) which describes a good interface as performing many of the roles of a good butler. A good butler help a person enter, exit, and move from room to room within a house. Additionally, a good butler learns the preferences of visitors, bringing them beverages they like, and learning to small-talk about the visitor's interests. A good butler however, doesn't interact with visitors on a learning level. A butler isn't typically trained to assess where the learner is, where the learner needs to go, and the best strategy for getting the learner where they need to be.

Schwier and Misunchuk (1993) address interaction on the learning-level, by identifying the need for core and complementary instructional zones in an instructional interface, as well as the need for interactive feedback. Core information zones refer to a consistent placement of key instructional information. Complementary zones refer to consistent placement of instructional elaboration, if needed. An example of core information might be descriptive information about a task, such as changing a bicycle tire. An example of complementary information might be a drag and drop computer environment that would allow a learner to practice changing the tire by dragging and dropping the appropriate objects in a correct sequence.

The ET model combines the butler model (Hoekema, 1984) with Schwier and Misunchuk's (1993) core and complementary information zones by recommending four overall teacher functions be embedded into a GUI: 1) Orienting the learner, 2) Providing navigational assistance, 3) Providing instructional strategies (core and complementary information zones), and 4) Providing interactive feedback. Altogether these four elements work to perform the essential tasks of a "live" teacher. Table1 below lists anticipated questions for each of the four teacher functions. By addressing each of these questions, a designer is able to embed the supportive roles played by a good teacher.

Table 1.
Embedded Teacher Functions.

Anticipated Questions For Each Teacher Function
Orienting The Learner What is the topic of learning? How do I begin learning? What is the nature of the learning climate? Friendly, fun, serious, scholarly? What is the breadth of the learning environment? What, in general, is expected of me in this learning environment?
Providing Navigational Assistance What is the depth of this environment? Where am I in this process? Can I mark where I am in the process? What do I do now? What do I do next? How do I proceed here? What is the decision-making process that I must follow? How do I go back to what I just did? How do I get out of this?
Providing Instructional Strategies How do I interact with this instructional strategy? Can I get more/less information? More or less examples? Can I skip this information?
Providing Interactive Feedback Am I doing the right thing? Am I right/wrong? How did I end up here? Can I undo what I just did? Can I customize this?

The Embedded Teacher (ET) model (Table 2) presented uses the framework of the ADDIE design model. ADDIE is the acronym for the Analysis, Design, Development, Implementation and Evaluation phases of the instructional design process. The following section describes how each stage of the ADDIE model was used to address the ET model when creating a GUI for a university course teaching *Corporate Course Design*.

Table 2.
The ET Model.

ADDIE Stage	Description of ADDIE stage and embedded teacher implementation
Analysis	The analysis phase involves front end investigation of learner, content, and task and how these variables influence the design of instruction. Analysis of content sequencing results in the design of the basic GUI navigational structure. *ET functions addressed at this stage include:* • Orienting the learner • Providing navigational tools
Design	The design phase addresses how instructional goals and objectives shape instructional strategies. Instructional strategies are shaped into core, complementary, and interactive feedback information zones. *ET functions addressed at this stage include:* • Providing instructional strategies • Providing interactive feedback
Development	The development phase addresses the tools and processes used to create instructional material. *ET functions addressed at this stage include:* • Coding the GUI and creating all multimedia elements
Implementation	The implementation phase addresses the execution of the instructional materials or program in a training environment. Learners use the GUI to take part in training/instruction. *ET functions addressed at this stage include:* • Observing how learner's interact with the GUI
Evaluation	The evaluation phase addresses both formative and summative assessment processes. *ET functions addressed at this stage include:* • User-testing the GUI for effectiveness, efficiency, and appeal • Addressing how well the product orients learners, provides navigational assistance, presents instructional strategies, and provides interactive feedback

The Analysis Stage

During analysis the designer identifies learner, content and delivery needs. The designer's goal is to match the form and content of training with learner needs and preferences. The designer becomes familiar with the format of content at a high-level and is able to address

thematic elements of the instructional interface. The designer arranges content into a presentational sequence and establishes "the lay of the land."

Analysis Questions

"What is the instructional topic?" is addressed for the *Corporate Course Design* class by placing the topic in a prominent location (see letter A in Figure 1) and by using an image of corporate architecture. "What is the breadth of the course?" is addressed by providing an overview of the entire course in the left section of the GUI. Project numbers and semester dates show course scope (see letter B in Figure 1). "How do I get started?" is addressed by the words "Start Here" accompanied by a prominently displayed arrow. Project numbers identify a sequence for learners to follow (see letter C in Figure 1). "What is the instructional climate?" is addressed using corporate look and feel (see letter D in Figure

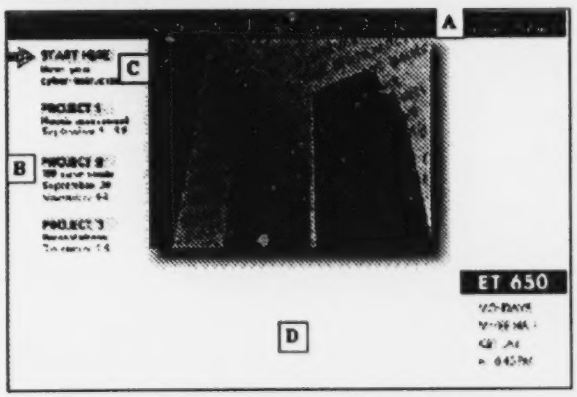

Figure 1. Orientation Functions Identified During Analysis.

Navigation Questions

"What is the depth of this environment?" is addressed (see letter E in Figure 2) using a flowchart structure to represent submenu sections. Each element on the flowchart represents a major task/lesson. "Where am I in the process? Can I mark where I am?" The large arrow (see letter F in Figure 2) marks the learner's location in the lesson, serving as a *You are here* reminder. Learners, however, cannot mark where they have been in the program. It's up to the learner to remember which sections of the program they have completed. "What do I do now, next? How do I back up?" The flowchart metaphor (see letter G in Figure 2) guides learners to complete the highest element on the flowchart before completing lower elements. Learners can click on previous sections to back up. "How do I get out of this?" Clicking the home button (See letter H in Figure 2) allows learners to exit.

The Design Stage

During design, the designer uses information from the analysis stage to create instructional strategies which address the instructional goals and objectives. These strategies are shaped into core, complementary and interactive feedback information zones. Core information zones are used for the presentation of key instructional content. Complementary information zones are used to provide learner practice and elaboration. Interactive feedback zones are used to provide learner assessment and remedial feedback. For the *Corporate Course Design* course, these zones were established using a *teacher* icon and a *conference room* icon (see Figure 3) for presentation of core information, and a *drafting table* icon for complementary information. Interactive feedback was implemented using the *briefcase* icon and the *teacher* icon. The teacher and conference room icons branch to pages which present background information and requirements. The drafting table icon provides instructions and space for learners to practice what they have learned. The briefcase icon allowed learners to submit work. The teacher icon in subsequent sections of the lesson responds to learner's work by making suggestions, addressing weaknesses and strengths (interactive feedback).

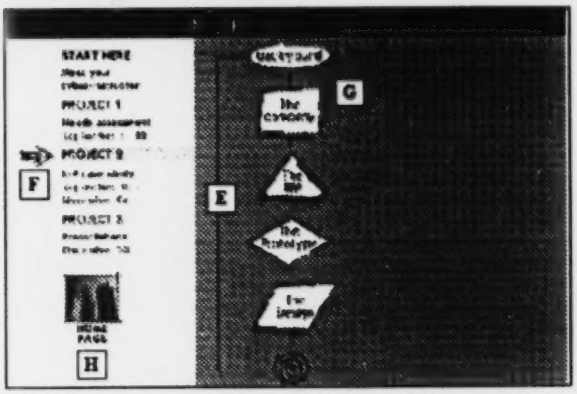

Figure 2. Navigation Functions Identified During Analysis.

Instructional Strategy Questions

"How do I interact with this instructional strategy?" Numbers next to the teacher, conference room, drafting table and briefcase icons (see letter I in Figure 3) indicate a sequential order for the learner. Instructions next to numbers describe in general terms what the learner is to do. "Can I get more/less information? Can I skip information?" is addressed by putting all of the tasks the learner must perform in the same visual space (see letter J in Figure 3). Learners control the amount of information they receive by clicking or not clicking. Because all relevant information is contained in the same visual space, learners see the "big picture" and understand the context of what they are choosing to explore or skip.

Interactive Feedback Questions

"Am I doing the right thing? Should I be doing something differently?" is addressed using the teacher icon

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(see letter H in Figure 4) to approach learner performance. The words "Good work" let the learner know that they are on track. Suggestions for improvement and space for learner dialog are provided with the text box that has a LISTSERV function.

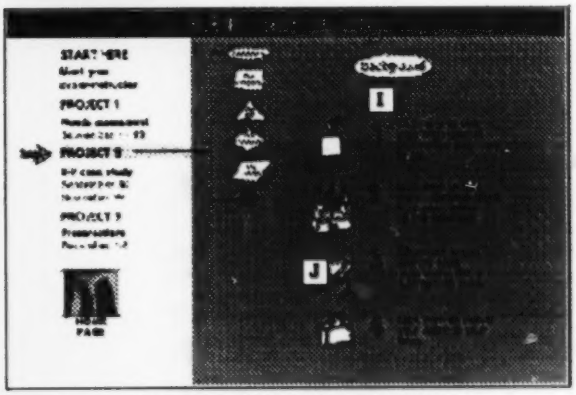

Figure 3. Instructional Strategy Functions Identified During Design.

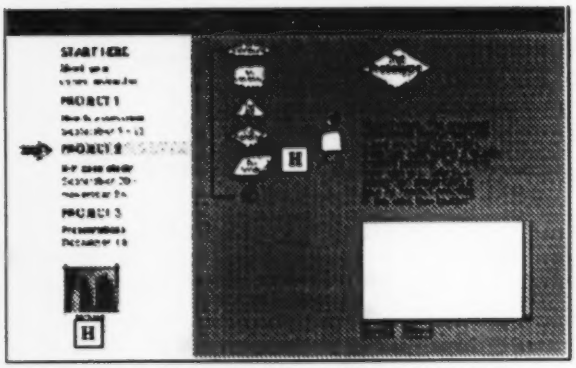

Figure 4. Interactive Feedback Functions Identified During Design.

Implementation and Evaluation Stages

User-testing of design, following recommended formative evaluation methodology (Flagg, 1990), will conclude the ADDIE process of GUI design for the *Corporate Course Design* class. User-testing will involve a series of one-on-one tests of the materials. Individual users will be asked to think aloud while working through the *Corporate Course Design* interface. Prompts to address each of the questions embedded into the interface will stimulate learner response if necessary. User responses will be used to modify the design and to identify additional questions needed by the ET model. After one-on-one testing, small groups of two or three individuals will test the interface. Again, user comments will be addressed by modification of the ET model and interface. The final pilot test of the product will be conducted in future semester sections of *Corporate Course Design*.

Future Studies

Several questions guide future evaluation and design of the ET model. One obvious set of questions must be asked: "Do the embedded teacher functions work?; Are learners able to direct themselves through instruction without the intervention of a live teacher?" To address these questions, a control group using an interface not implementing the ET model could be tested. Another question, "How direct (realistic) do teacher functions need to be?" can be addressed by comparing the interface presented in this paper with interfaces that are both more and less direct/realistic. Do users need to see the *lay of the land* to know where they are in a program? How much detail is needed to help users see the lay of the land? Does a separate syllabus need to be included into the interface, or can the syllabus be embedded into the interface? Until sophisticated technology that allows a simulated teacher (similar to Microsoft's personal assistant) to be easily integrated into Web courses, these and other questions can direct efforts in designing optimal learner control environments for Web learners.

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A Methodology for Software Evaluation

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When attempting to evaluate software for education, the goals of the learners and the instructors need to be explic-itly stated from the outset. For example, considering a specific piece of software adequate simply because it is labeled 'multimedia' is not acceptable. As pointed out by Nyns (1989), a teacher's starting point in using Computer Assisted Language Learning (CALL) should not be "what can I do with my PC?" but rather "which medium is best suited to teach such and such a skill?" (p. 36). To which we would add - to these students, in this school, and on this type of computer system.

Evaluators must make a series of decisions about which issues have a direct impact on their choice of software. Instead of attempting to find an existing checklist that is in agreement with their own purposes, they should create their own checklists based on what they have determined to be the pertinent issues.

The procedure is as follows: evaluators define their instructional context by determining (a) who the learners are; (b) who the instructor is and the learning environment; and (c) what the 'raw' technical limitations are. Consequently, with this defined, the instructional goal may be determined. This, in turn, helps them develop statements about the type of software that will meet their needs. At this point, they would choose and weigh checklist items which they believe will aid in answering the question: "What is the best software in this context?". Potential software candidates can then be identified and evaluated using this newly created, context-specific checklist.

Instructional Context Analysis

If one wishes to make a prudent purchase, one must analyze, beforehand, the context in which materials will be used — to ensure that various needs are met. A new instructional technique may only be appropriate in certain situations, as is the case with computer software. The time spent conducting this analysis will save time and money, as the products which are purchased will better reflect the needs of those affected.

Identify Learners

Smith and Ragan (1993) have produced an outline of learner characteristics that can be used to analyze and describe almost any target audience. The list is quite lengthy (for explanations and examples see the original text) and it is suggested that one not use every category. Instead, it should suffice to use only those which are most relevant to the context and which help in delimiting the characteristics and interests of the given learner population.

a. Cognitive Characteristics. (i.e. Development level (such as Piaget's levels of cognitive development), Reading level)
b. Psychosocial Characteristics. (i.e. Interests, Motivations, Anxiety level)
c. Physiological Characteristics. (i.e. Sensory perception (visual and auditory acuity), Age)

Identify Instructor and the Learning environment

This step is important to ensure that if a purchase is made, the product will be given a positive reception and some environmental support is in place to secure its effective use in the classroom (Smith & Ragan, 1993, p. 31).

Issues that are important to examine because they directly address the needs of the teacher and therefore inform the software evaluation are:

- Feelings towards computers in education - What are the educator's attitudes and opinions? If teachers are reluctant or negative then the mere introduction of software — regardless of its quality — may be a waste of time and money. Administrative support or training may be helpful.
- Interests and preferences of teacher - What are her interests outside the content matter? Some software may be more intrinsically motivating due to its relevance to her interests and teaching styles.
- Experience level of teacher - How much experience does she have with the content, learners, media and teaching in general?
- Curricular/instructional goals - What are the specific goals that should be addressed by the product?

- Administrative needs - Will the teacher need the software to collect and save data for administrative purposes such as attendance; achievement; time on task; and the paths the learner has taken through the software?
- Administrative environment - Do the administrators support the integration of computer technology in the classroom? Can they be counted upon to provide training, incentives and/or time-off for the instructors to become proficient with computers?

Identify Technical Needs

This may be the most simple and straightforward aspect of the instructional context analysis (depending upon the technical knowledge of the evaluator). The purpose of this stage is to explicitly state the maximum and minimum requirements of the physical resources on which software will be used.

- Who? The best sources for the information one requires are the people who purchased, installed and maintain the system. The issues to consider when speaking to these informants are:
- What? Type of computer - Determine operating system; processor speed; size of hard drive, RAM; monitor type (color?) and size; multimedia capabilities (sound, video and CD-ROM speed); modem speed; and networking capabilities.
- What else? Peripheral devices - What other kinds of devices are attached to the computers? Printers, scanners, mice, microphones, removable media drives or projection systems.
- Where? Number and configuration - How many computers are there? Are they in a lab or in classrooms? Are they connected by a network and if so, what kind? Do they have Internet access?

Instructional Goal Analysis

"Ask not what a computer can do to students, but what students can do with a computer." David Thornberg (as quoted in Ryan, 1997)

The next step is to determine the instructional goal that the software should fulfill. This goal will give context to the ultimate question "What is the best software?". It will contain the pertinent information about the learner; teacher and learning environment; and technical needs. It will also include a statement related to the functionality and/or type of software desired; and the instructor's beliefs about the learning process.

The terms which help define this statement depend upon some philosophical issues that the evaluator needs to consider:

View of software

Software that will be used in the classroom comes in many forms. Taylor (1980) created a distinction among software - tutor, tool and tutee (e.g. Romeiser & Yerem, 1994). A tutor can be seen as a surrogate teacher, a tool takes student input and generates output which is used by the student in a task, and software that students use to 'teach' the computer are considered tutees. Software that is not instructional in nature would not fit into these categories. For example, Taylor's taxonomy (1980) cannot properly deal with Internet browsers which are not instructional but have the potential to become standard applications in many classrooms.

More importantly, it may be argued that these classifications look at the question of computers in education only from a technological point of view (what can the computer do?) and hardly consider what many would feel is the most integral part of the instructional context - the learner (what can the student do with the computer?).

Using Dewey's (1943) 'Natural impulses of the learner', Bruce & Levin (in press) suggest that software be classified by how the learner can use it in meeting these impulses — thus the categories media for inquiry, media for communication, media for construction and media for expression emerge. This change from the 'technocentric' to a more learner centered point of view fundamentally changes how one phrases the statement of the instructional goal.

For example, if one asks "What kinds of games teach punctuation in an English as a Second Language (ESL) classroom?", an assumption has already been made that a game — a category that is becoming more difficult to define — is the appropriate option. The exploration of possible software titles has been needlessly limited. However, if one looks from the learner's perspective, the question becomes something like: "With what media can a student examine (media for inquiry) and practice punctuation in an ESL classroom?". This question, in turn, may be answered with a punctuation game, concordance application, grammar checker and the traditional 'paper and pencil' workbook. The scope of possible applications has been greatly expanded beyond those that the category 'game' could yield.

Theory of Learning

Software developers have beliefs about how people learn and interact in different environments. By critically examining and comparing computer applications, often these beliefs can be deduced. In the same way, teachers have strong beliefs about how best certain content or concepts can be taught to different learners.

If an evaluator wants to find appropriate software that will be used to fulfill a particular instructional goal, then the learning theory which was used in the program's development must reflect the teacher's tacit theories of learning and instruction.

As a consequence, during this process, "software may be found inappropriate rather than ineffective" (Miller &

Burnett, 1986, p. 159). With reference to the previous example, if the teacher believes strongly that students can best examine punctuation inductively and then practice it by writing compositions then a 'behavioristic' game would not be appropriate and probably would never be used in that classroom.

Therefore, at this stage the evaluator would ask the question "What does the teacher believe is the best way for the instructional goal to be met?" and then ensure that possible software choices reflect this. With this information, the evaluator will have once again narrowed the focus of the search and made the selection process more efficient and, possibly, more successful.

Issues to consider when developing a personalized software evaluation checklist

Content
- Quality
  - Learners
    - Appropriate vocabulary and subject matter for target audience
    - Well written and grammatically correct texts
    - Variety of explanations and examples
  - Teacher
    - Features which take advantage of the computer
    - Easy procedure for modifying, adding or updating content
    - Clearly stated objectives
    - Outlines, summaries and reviews
- Depth
  - Learner
    - Versatility
    - Numerous and 'just in time' explanations, examples, and illustrations
    - Presents 'correct' examples, non-examples and mistakes most commonly made by learners.
    - Situates the examples within a context
  - Teacher
    - Applicable in a variety of teaching/learning situations
    - Meets the instructional goals
- Tests
  - Teacher
    - Systematic review of learned materials
    - Coincide with objectives
    - Presented appropriately

Interface
- Ease of Use
  - Learner
    - Entered answers or selected alternatives should be able to be deleted.
    - Changes to the environment through menu options
  - Teacher
    - The program is simple to use
  - Technical
    - Simplicity in its loading and running instructions.
- Navigation
  - Technical
    - Timing is self-paced and flexible
    - Ways to go back one step or go back to the main menu, etc.
    - Help or hint options
    - Exit and review instructions
    - Text or images that are hyperlinks should be clearly indicated
    - The 'granularity' (number of links to other screens) should be level appropriate
    - The cursor should not appear if it is not possible to use it
- Text Quality
  - Learner
    - Font is large enough
    - Clear and easy to read (including text inside buttons)
    - Glossed, with pop-up references
    - Symbols and icons should be obvious or, if tried once, easy to remember
- Graphics
  - Learner
    - Style and graphics are suitable
    - Graphics clarify or enhance the points being made
    - Familiar objects should be included in illustrations
    - Illustrations are clearly labeled and as close as possible to the text to which they refer
  - Technical
    - Graphics would improve the program
    - Still images do not interfere with the text
    - Consistent use of symbols
    - Overall quality and clarity of displays
    - "Current video standard (QuickTime)
- Sound
  - Learner
    - Voices are intelligible
  - Technical
    - Sound constitutes an essential or integral part of the program
    - Appropriate use of voice over music
    - Quality recording and playback features

Interactivity
- Feedback
  - Learner
    - Helpful messages to aid in the correction of errors.
    - Types of feedback
    - Immediate
    - Delayed
    - Summative
    - Types of branching feedback
    - Review
    - Remedial Audio
    - Single/Multiple Remediation
    - Unpredictable patterns

Technical
- Processing time

Sequence
Learner
- Linear or fixed sequence
- User directed
- Hyperlinks
- 'Open' in that there is no predetermined sequences
- Avoids putting learners in infinite loops or sending them to dead ends

Teacher
- The instructor can order the topics for presentation

Technical
- Acceptable time delays

Questions
Learner
- Those asked by learner
- Questions of clarification
- Key word searches
- Complete sentences
- Those asked of learner
- Categories of questions
- Appropriate to the audience
- Related to the content
- Randomized

Classroom related issues
Entry Level / Technical Requirements
Learner & Teacher
- Entry level skills and knowledge (keyboarding, mouse, navigation)
- Amount of basic or remedial training required
- Level of computer literacy skills

Technical
- Compatibility of the system's requirements and the minimum requirements
- The availability of site and distribution licenses
- Total cost

Motivation
Learner
- Motivating and challenging as a whole
- Novelty (vs. lasting) effect

Backwash
Teacher
- Provides teacher with information/insight into students' strengths and weaknesses
- Provides teacher with ideas for instruction
- Structure/content mirrors classroom activities
- Allows teacher to 'offload' some tasks

Management
Learner
- Creates a 'history' of the path taken through the program
- Allows one to save one's work/position
- Multiple-user profiles

Teacher
- Ease of implementation
- Audit Trails
- Diagnosis of difficulties

Support
On-Line Help
Student
- Key word / topic searching
- Glossary / Index
- Pop-up menus
- Tutorials
- Ability to annotate

Teacher
- Ability to annotate student help

Technical
- Unambiguous on-screen options
- Uses 'help' key
- Other on-line help

Off-Line Help
Student
- Pre-Printed workbooks and guides
- Print-outs of help topics and/or annotations
- Lists of suggestions for study, resources or bibliographies

Teacher
- Clear instructions on how to operate the program
- Instructor's guide

Technical
- Clarity in its documentation
- Telephone support and fax-back services

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Using LearningLinks to Construct and Evaluate Content Modules

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Instructional applications of technology are rapidly expanding, but their utility is often diminished by limited flexibility and low user-friendliness. Furthermore, most content-based instructional software fails to provide immediate relevant feedback either to the learner or to the teacher who uses it. This paper describes a tool that is designed to meet these challenges. LearningLinks (Strang & Schoeny, 1997) is a Windows-based instructional tool designed to create self-directed learning modules. Currently modules are being developed for post-secondary applications. This Visual Basic software tool allows teachers to develop interactive lessons that can be used by students in self-directed study. Lessons can be developed in any instructional area that involves a link between pictorial and textual content. This teaching vehicle is well suited to achieve direct instruction outcomes such as learning definitions, spatial orientations, and interrelationships among content elements. It can also be used to promote higher level problem-solving outcomes. Once authored, lessons are self-administered by students via a stand-alone runtime module.

LearningLinks can be used to implement direct instructional objectives such as learning definitions, spatial orientations, and interrelationships among specific content elements. It can also be used to promote higher-level learning that includes exploratory and problem solving activities. The program's instruction and testing functions center on a student's interaction with a series of frames, each containing several layers of information and cues pertaining to the instructional unit. Student learning is maximized through LearningLinks' application of powerful principles such as prompting, feedback, reinforcement, and practice (Strang, Badt, & Kauffman; 1987 Strang, 1997)

Even with minimal computer literacy, instructors quickly learn to combine text and graphical materials to create highly individualized instructional or testing experiences for their students. In turn, students quickly learn to navigate these instructor-authored modules. A key component of LearningLinks allows instructors to easily develop a variety of feedback reports that clearly define both specific and global aspects of student performance during instructional or testing experiences. These reports can be used by the instructor for assessment and/or can be shared with students during debriefings. The data used for the feedback reports can be used to research the quality of the content modules developed for student learning.

Encouraging results defined by both student learning and participant enthusiasm have been obtained from two pilot applications. In an Audiology course, an instructor-authored module helped students to comprehend the spatial organization of the structures in the human temporal bone, and in a child development course, another module helped students understand both similarities and differences among key psychological concepts.

Lesson Development Options

This section focuses on LearningLinks lesson development capabilities. An actual authoring session will be used to illustrate the key aspects of each of the four lesson-planning phases listed on the Utility Menu (see Figure 1). A summary of the major features of each of these phases follows.

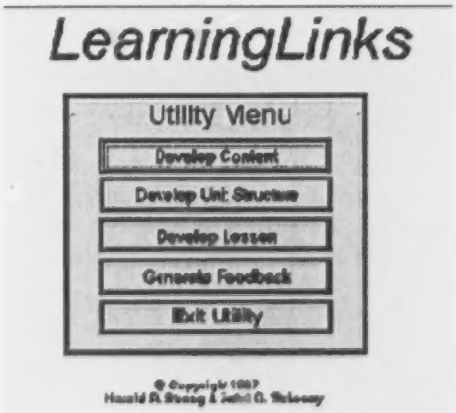

Figure 1. Initial screen for the LearningLinks Development Utility.

Content Development

During this phase, the module's basic content elements are gathered and integrated. These components may consist of a series of text blocks and/or graphical structures that will be integrated into the instructional or testing frames. A 'Vocabulary Builder' module facilitates the generation of text blocks. Since the vocabulary files that house these blocks are simple ASCII files, word processing software can also be used to develop these files. When a word processor is used, however, ".glo." must always be the extension in the file name.

Unit structure development

During this phase, the unit title, frame titles, and frame subtitles (if desired) are first defined. Next, the basic content elements developed in the first phase are used to construct the unit's basic frames. During this authoring, as many as 12 separate hotspots can be individually sized and imbedded in each frame. Finally, As many as 10 frames can be serially linked.

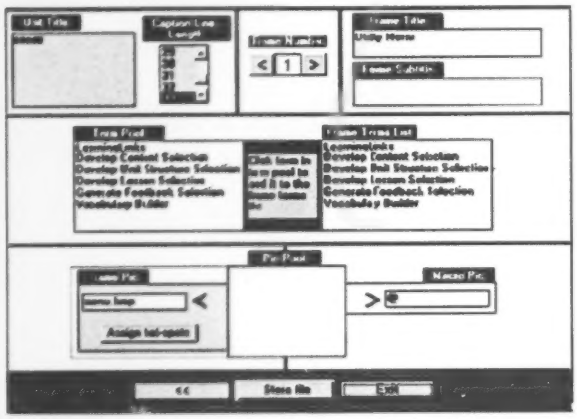

Figure 2. Unit development module.

Lesson development

This phase allows the author to use the unit structure developed in the previous phase to construct either an instructional unit or a test. During the development of an instructional unit, the on-off setting for each of the unit's 10 navigational buttons is determined. During the development of a testing unit, specific frame sequences are selected, test items and testing types within frames are chosen, and post response feedback is determined.

Feedback Generation

This phase offers the following three options: a) the first allows for creating a data file that houses pertinent information on the performance of each student that completes the current lesson; b) the second allows the printing of individual student test results, and c) the third allows for printing two different reports of collective student performance results relating to the instructional lessons. The Navigation Record gives a complete history of student movement through a lesson, clearly documenting each decision and its temporal benchmark. The Learning Pattern Report lists quantitative measures of lesson performance in six majors areas ranging from basic lesson navigation to the frequency and content of student-initiated note taking activities.

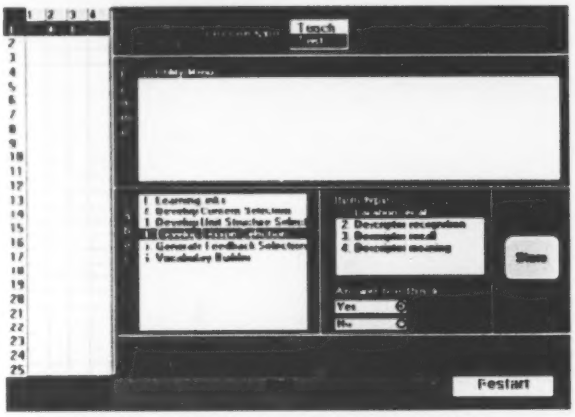

Figure 3. Test development module

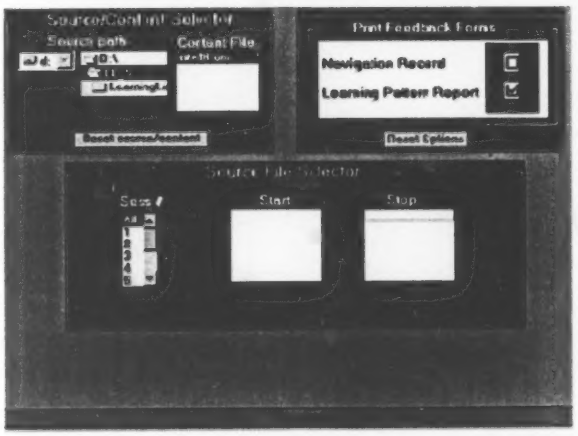

Figure 4. Feedback development module.

Future development

A major thrust in developing LearningLinks is currently being directed toward expanding the tool's library of applications. Particular emphasis is being placed on creating a diversified library of post-secondary modules. Faculty from a variety of disciplines at the Curry School of Education have volunteered to participate in this authoring process. Faculty at other postsecondary institutions who are interested in participating in cooperative research efforts are encouraged to contact the authors.

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INDICATORS OF GOOD SOFTWARE LEARNING TOOLS

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For twenty years, educational technology literature has maintained that most educational software does not meet its promise. There are, however, some excellent programs that enhance teaching and learning. In addition, many programs contain laudable features that are worthy of notice. Eighty-one graduate students reviewed state-of-the-art hypermedia/multimedia software, across the grades and subjects, in search of indicators of good software learning tools. The objectives of this experience were to identify both good ideas to replicate and bad ideas to avoid, in order to shorten the software development learning curve and to develop model, prototype products. A serendipitous outcome of the analyses was a heightened awareness of valuable indicators that assist in the selection of software materials for learning and training.

This presentation discusses elements that contribute to successful, computer-supported learning. Within the paper are ideas organized into two major categories, the learning environment and person-machine communication, i.e., the software.

Learning Environment

This section addresses conditions relevant to a positive environment for learning. Papert (1980) described a student-and-computer system as a place called microworlds where certain kinds of learning could hatch and grow. Let us extend Papert's metaphor to encompass the immediate universe experienced by the program user, i.e., the setting in which the computing use is done. Today's hardware is a multimedia, networked computer. Settings include one remote learner with a computer, a one-computer classroom, a classroom with shared computers, and/or a classroom with individual computers. In terms of software, some programs are tutorial – materials that provide instruction; others review and reinforce instruction, drill-and-practice; still others are tools for experimentation and construction. Whatever the combination of hardware, software, and learners, together they constitute a microworld, an environment where learning may take place. Following are observations and recommendations about building the environments not necessarily in any sequence.

General recommendation from the users to the developers:

- Challenge provides motivation.
- Learning, at all levels, may be fun.
- Elements of surprise (pleasant, not scary) are pleasant.
- When sections of a courseware program may be used independently, provide a map that highlights (or otherwise indicates) successfully completed sections.
- A boring program will be abandoned.
- Prepare a "how to use this product" video. Make it available with a hyperlink on the splash screen.
- Bookmarks allow users to continue from previous sessions' stop points.
- A new version of a program should be a well-debugged improvement.
- Always look to see whether computer is the medium of choice for product.
- Users should control pacing. Timed "reminders" may be used to tweak inactive users.
- Transmitting information does not equal instruction.

General recommendations from teachers to developers:

- Start with an advance organizer (Ausubel, Novak, & Hanesian, 1978).
- Provide learning objectives and never lose sight of them.
- Product should meet the conditions of learning (Gagne, Briggs, & Wager, 1992).
- Lists of ancillary material help integrate the technology into the learning process.
- A good teacher with appropriate resources will envision novel ways to use a program.
- A product may be reviewed by an experienced teacher (or trainer or librarian) but really needs to be tested by target users for best decision-making.
- Observing the target population using the software for the very first time is very instructional for design and for purchase decisions.

- Provide pointers for teachers in obtaining subject expertise.
- Unless a program is totally intuitive, time must be borrowed to learn to use it.
- This time is not easy to replace.
- Individualize instruction by providing problems based upon performance.
- Some subjects must be learned in linear fashion.

Recommendations specific to pre-school computing:

- Development should be based upon principles of pedagogy – the science of teaching to children.
- Older children happily mentor younger ones during initial experiences with a program.
- Some early childhood software is really child-with-older-person experience.
- Parents/teachers who will be working with young children appreciate "models of intended use" videos.
- Children who use programs without supervision are likely to miss some of the best features.
- Children expect screen objects to be hot spots.

Recommendations specific to adult computing:

- Development should be based upon principles of andragogy – the science of facilitating adult learning (Bullard, Brewer, Gaubas, Gibson, Hyland, & Sample, 1994).
- Most good programs have narrowly defined target audiences.
- Novice, computer-using adults are more likely to persist if patient human support is available.
- Wizards, magicians, and agents are often welcome on-screen guides.
- A truly intuitive program should not require a help feature.
- Label icons. Adults do not recognize "rebuses" as readily as do children.
- Provide varying methods for learner self-evaluation.
- Begin with clearly defined learning objectives. "In this lesson, you will ..."
- The computer experience may guide a real-life one. Instruction in cooking, wine tasting, and playing of musical instruments calls for off-screen activity.

Person-Machine Communication

The field of endeavor that examines the communications processes between the program and the user is called Human-Computer Interface/Interaction (Shneiderman, 1998). By definition, a well-designed program interfaces successfully. All instructional design issues must be tested for their ability to communicate well. This section addresses different aspects of the design and implementation processes. Which of the alternative suggestions is best depends on the subject, the learners, and the objectives of the program.

Links, buttons, and icons:

- Make icon (button, link) large enough so that poor-mouser is not frustrated.
- Keep icon areas sufficiently apart so that accidental clicks do not occur.
- An inconspicuous "teacher" icon could call up suggestions for further learning.
- Simulations that mirror reality should feature invisible icons.
- Provide enrichment accessed with an "extras" icon.
- When mouse passes over icon, label should pop up.
- Use a voice icon to bring up audio help.
- Use a document icon to bring up printed help.
- Provide a "What do I do next?" icon.
- To help users extend their vocabularies, make new words hotspots that bring up definitions and/or images.
- An index icon on the navigation panel allows for true self-directed learning assuming all indexed items are hyperlinks.
- Avoid moving buttons that need to be clicked on.
- Always make links "dynamic"; the shape of the mouse should change when it passes over a link.

Internet links:

- Internet links greatly expand learning resources.
- Internet links usually allow the user to link elsewhere making it easy for the user to become irretrievably lost.
- Using simulated links (resources that are contained within the program) solve the "getting lost" problem.
- Programs with simulated links must be upgraded often to avoid "staleness".

Sound, voice, music:

- Where oral pronunciation is an issue, use a microphone to capture user's voice. Play back voice. Let user compare own voice with computer-tutor's rendition.
- Evaluate user's pronunciation with speech recognition software.
- Synchronize voice output and on-screen lip movements.
- Keep music on a toggle (on/off) switch.
- Consider using "snippets" of music as rewards.
- After a while, the camera shutter click grows annoying.

Feedback, rewards:

- Feedback should be immediate, relevant, and useful.
- Feedback should be provided often in an interactive experience.
- Inform learner when answer is wrong. Do not repeat original phrasing
- Feedback should address why answer is wrong.

- Looking for an exact match in an answer may cause an essentially correct response to be evaluated as incorrect. Solution: multiple choice answers.
- After two wrong tries, provide user with correct response. Never trap user in failure cycle.
- Do not put learner through identical process repeatedly. That is punishment.
- Easy-to-program rewards include praise words, happy sounds, award ribbons, animation.
- Reward should be appropriate for activity. Winning is a reward.
- Rewards may be cumulative if the program is used over time.

Images:

- Decide on a metaphor to give the program cohesion. List all possible artifacts that would typically be found in that universe and use them as hotspot objects.
- Images must be clear and relevant to the content.
- A well-placed picture is often better than explanatory text.

Text:

- Define all terms that will be used in the instructional process.
- Keep instructions visible or retrievable with toggle switch.
- Bold, black lettering on white background is easy to read.
- Limit the number of words on a screen at any given time.
- Always allow the user to read at own pace.

Content:

- Content must be micro-checked for correct spelling, grammar, sentence structure and factual accuracy.
- Always use multiple resources to ensure accuracy of facts.
- Choice of materials for inclusion should embrace expert opinions.
- Have the computer generate progress reports periodically.
- Provide enrichment opportunities.
- Provide suggestions for improving performance.

Conclusion

There is no end to how much may be learned through analysis. Teachers who develop software or who guide their students in the development of software projects, experience virtual field experiences when reviewing a sampling of current offerings in a given subject and age/ability range. Examining products created with commercial budgets provides insights into today's technology potentials and opens doors into an existing universe.

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TEACHER-DRIVEN DESIGN OF EDUCATIONAL SOFTWARE

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In this paper, I reflect on my participation in two government-sponsored courseware development projects. Though neither project was modeled on the other, both used a holistic design paradigm in which classroom formative assessment and teacher input played a critical role in the development process. The two projects were —

- R-WISE (Reading and Writing in a Supportive Environment) – a learning environment to teach writing at the 9th and 10th grade level. The project was a timely collaboration among the military, business / industry, and the educational community to address one of the most pressing challenges facing our nation: teaching the thinking skills necessary to participate in a complex, modern society. R-WISE was developed by the Air Force's Armstrong Laboratory in partnership with MacArthur High School in San Antonio, TX. Over the course of the project (1990-1995), the software was implemented in several different states and used by thousands of students (Carlson, Hitzfelder, Hudson, & Redmon, 1996).
- BioBLAST (Better Learning through Adventure, Simulations, and Telecommunication) – a content-rich learning environment that mirrors research being carried out at several NASA centers. The project (1995-present) consists of simulations, microworlds, and interactive multimedia based on NASA's Controlled Ecological Life Support Systems (CELSS). Sustaining humans in colonies beyond earth's environment requires a balance among components and systems. Focal points of research include: (1) plant production, (2) human requirements, and (3) resource recovery. The target audience is 9th and 10th grade biology. Using the "tools," laboratory activities, and collaborative interaction, student teams design and balance a closed biosphere to support a crew of six, living on the lunar surface (Carlson, Ruberg, Johnson, Kraus, & Sowd, in process).

In each of these projects, high school teachers were part of the design team from the beginning, and both alpha and beta versions were field-tested in classrooms, representing adequate numbers and diversity to make the feedback useful. But more than these similarities, in each project the "development team" was as a multi-talented collaboration involving domain experts, instructional designers, software engineers, curriculum writers, and classroom instructors. The teachers were regarded as fully-vested members in the process.

Educational Software — Promise and Puzzlement

Increasingly, K-12 educational technology has come to mean some form of computer-mediated product. More affordable hardware, increasing awareness of new media (information technology in general), and the combined push from reform mandates and the pull of marketing for new media all contribute to an environment of rapid change.

Yet, reports both from the workplace and from higher education indicate that meaningful integration of advanced information technologies is not a matter of simply making the hardware / software available. For example, Geoghegan (1994) estimates that of all the educational technologies implemented in higher education, no more than five percent of instructors use computers as anything more than high-tech substitutes for the blackboard and the overhead projector.

On the K-12 level, many multimedia educational products available today are conceived of as "super-books." They present students with multi-modal representations of materials and explanations, but their "pedagogy" is primarily didactic and their assumptions about learning are fairly static. Increasingly, we are seeing a backlash in the popular press against advanced educational technologies. The claims center on charges that most software engages only at a superficial level and — over time — both "deskills" the student and "disenfranchises" the teacher.

In general, educational software has not reached its potential for a variety of reasons. I suggest that these inhibitors can be clustered under four categories:

- Lack of meaningful formative evaluation – While change is in the offing, the current-traditional design methods for courseware/educational software do not include adequate feedback loops. Although this may be typical for an "immature" industry, it is to be hoped

that developers of educational technologies will at some point have as much regard for product design and end-user needs as does the automobile industry.

- Emphasis on the student as end-user – Certainly, the learner (primarily, the learner's measurable achievement) drive much of today's concern for educational reform. However, a technology-enabled curriculum should be conceptualized as a dynamic partnership among three agents: the student, the teacher, and the computer-mediated learning tools.
- Lack of a robust new paradigm for technology in education – Education's recent history contains several examples in which a new entity emerged in a glow of promise but never reached fruition. We seem to be at that awkward transition point for computer-mediated learning — one in which the old methods are falling away, but the new paradigm, enabled by advanced information technologies, is not apparent.
- Overemphasis on teachers as technophobic – Too often, the teacher's role in technology adoption has been characterized as inhibiting and conservative. While advanced technologies may be a threat to some instructors, dwelling on negative "attitude" and on the need to "educate" teachers on hardware and software operation misses the real strengths teachers can bring to the process.

Collaborations for Progress

Figure 1 accounts for a spectrum of features in the "ecology" of education. This model suggests systematic and defensible design/evaluation of software / courseware in situ to promote "best teaching practices." Furthermore, the model implies consideration of a range of issues including integration of information technologies into existing curricula (easing the transition from traditional to innovative), establishing creative partnerships among students, technologies, and teachers, as well as selecting courseware /software for specific needs.

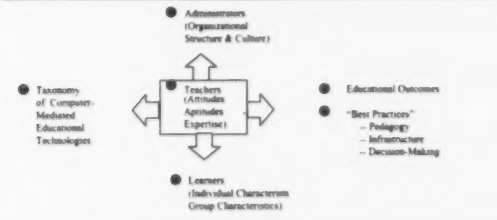

Figure 1: The Ecology of Educational Technologies.

As indicated in this schema, the teacher is the nexus for many issues of integration / implementation, administrative policy, assessment, and educational reform. The remainder of this paper extracts from the teacher commentary in both BioBLAST and R-WISE a set of characteristics these classroom experts believe should be instantiated in truly effective educational software. I will present these observations under two headings: first, features that enhance the teacher's effectiveness in the learning process; and, second, features that encourage students to become active participants in the learning process.

Software that Allows Teachers to Become Mentors and Facilitators

For this section, I will look specifically at the BioBLAST project, and focus on how this content-rich learning environment embodies emerging changes in science education. The radical shift away from lectures, decontextualized experimentation, and textbooks demands a great deal from the teacher. The move to authentic, situated, and project-based learning mandates that teachers drop their authoritarian mantel and assume a master-apprentice relationship with the learners.

All of the BioBLAST teacher-leaders are accomplished educators who have enthusiastically adopted the new role for teachers of science. They were selected to work with the project through a nation-wide competitive application process. Their specific charge in the first fielding (1996 - 1997) of the BioBLAST CD-ROM was two-fold. First, as classroom experts, they were asked to comment on the appropriateness of the materials for their situation. Second, as skilled practitioners of the new pedagogy, they were asked to facilitate the "weaving" of patterns of effective usage from the many available activities. In essence, teachers were asked to serve as "sherpas" in finding paths of learning through the rich and intensive environment.

During the academic year of 1996 - 1997, teacher-leaders adapted the components of the program to their individual situation, providing feedback on their experiences and adaptations. I summarize here three specific software features driven by the teachers' remarks.

Developing Bridging Activities for Clarifying and Reinforcing Concepts

Students — even the most enthusiastic of learners — have few mature strategies for constructing meaning from even the most well-planned of classroom activities. Thus, the BioBLAST teachers underscored the need for devising software activities that model complex concepts or behaviors in small or more familiar domains of experience.

For example, most classes approach BioBLAST as a long-term, project-based activity within which to examine important biological concepts. The overall theme of the photosynthesis / respiration cycle between humans, plants, and the external environment lends itself to "energy usage" as a starting point, with progressively more complex examination of basic processes occurring as additional cycles (carbon, nitrogen, water, decomposition, respiration, and combustion) are added.

Using "Artifacts" to Foster Learning

Active learning is both product and process based. Ideally, constructing one level of "knowledge product" (or artifact) feeds into the process of attaining yet a higher level of understanding. For example, collected data can be analyzed for patterns and trends, from which the student may be asked to draw cause-and-effect inferences or formulate predictions or generalizations about future behaviors of the elements under study. The very richness of the BioBLAST domain challenged teachers to work through iterative cycles of process fostering a product which then initiated yet another process.

This "spiraling" upward from concrete to abstract was used well by a teacher who started her classes' BioBLAST experience by having each team construct a "quart-jar ecology" (snails, plants, bacteria, and the like). The classes also constructed a 5 by 9 foot human cell and investigated components and relationships. As the course progressed, these "microcosms" became analogs for the more complex and sophisticated macrocosms of Advanced Life Support (ALS) and other controlled ecologies. Additionally, these classes used hands-on experiments (mirroring actual NASA research interests as indicated in the software) to be particularly engaging. They posed questions and formed partnerships with NASA scientists for extending their investigations. For example, students will grow control plantings for an experiment in plant reproduction to be conducted on the space shuttle.

Sustaining the Sense of a "Community" for Scientific Inquiry

Meaningful implementations of collaborative learning require sustaining the intellectual rigor of scientific inquiry while at the same time nurturing the socio-cultural dimensions of group activities that foster respect for individuals and mutual dependencies among students and teacher for learning.

Many of our teacher-leaders insisted upon an open-ended quality for BioBLAST in order to foster collaboration between students and teacher in deciding upon evaluation standards. Discussing possible outcomes and constructing rubrics as a class activity lowers student anxieties and increases motivation. Promoting a constructivist approach to learning, teachers used guided-inductive techniques to help students define issues, determine problems to be solved, and exchange ideas in a series of positive interactions. BioBLAST also helps students establish communities beyond their local situation. Intra-school sharing of data on common experiments marked the "pilot" year. The 1997-1998 implementation has a "newsgroup" feature for students to share both data and reflections. Also, the program contains new opportunities for student to contribute to distributed research and to participate in NASA-sponsored student projects.

In essence, our teacher-leaders recommended that BioBLAST incorporate project-based and inquiry-driven learning, using both content and delivery mechanisms featuring an engaging context from which learners can generate authentic questions for in-depth inquiry. They further suggested that these student-defined investigations be carried out in a community of inquiry where classmates and teachers collaborate to complete complex activities and to produce artifacts available for meaningful assessment. Based on these recommendations, educational technologies (especially advanced media) should be "situated" and should foster collaboration and active learning.

Software that Encourages Students to Become Active Participants in Problem-Based Learning

For this section, I will look specifically at the R-WISE project, and focus on how this "cognitive tool" encourages students to view writing as a critical thinking activity. The past three decades of inquiry into the writing process have yielded a greater understanding of prose composition as a cognitive act. Specifically, Bereiter and Scardamalia (1987) draw upon years of empirical research to extract the notion of "intentional instruction," or explicitly teaching writing as a process of setting goals and achieving those goals through schema-driven strategies and metacognitive awareness.

R-WISE is based on the theories of Bereiter and Scardamalia. As a learning environment, the software provides scaffolding and visual algorithms that gently guide the writer through multi-staged intellectual activities. The software encourages students to practice powerful strategies for composing in a computer-mediated environment that fosters guided-inductive learning and ensures mindful engagement in the task. The entire R-WISE suite is made up of three sets of adaptive workspaces, each mediating the entire writing process but focusing on the strategies and self-regulative awareness characteristic of one of three domains: (1) finding ideas, (2) transforming ideas into prose, and (3) refining both ideas and text into final documents.

Modern pedagogy for teaching composition envisions dramatic changes for the role of the student. However, learners who have grown accustomed to the "traditional" pedagogy which places heavy emphasis on lecture, textbook, and drill may initially flounder when this structure is removed. Certainly, it is unrealistic to think that "little experts" will spontaneously emerge when confronted with an open-ended problem — no matter how intriguing the presentation. Nevertheless, with the guidance of our teacher-leaders, we were able to design software that produced advancements in students' participation in the process and understanding of the content.

Below, I summarize three specific goals that the teacher-leaders identified as crucial to a computer-mediated writing environment.

Improved Strategies for Inquiry

Modern pedagogy emphasize inquiry over lecture and demo. Certainly, the ability to write is engendered through intellectual curiosity coupled with reasoning and patience. R-WISE teachers asked that the embedded pedagogy emphasize improved problem-solving and enhanced critical thinking (asking "why" rather than "how") among students. A second common request was that the software help students to take on larger "chunks" of the process of composing and that students become more self-directed and capable of self-sustaining a high level of effort.

In response to these observations, R-WISE contains a series of "thinking frames" that mediate the transition from "novice" to "expert" behavior in composing. These "cognition amplifiers" ease demands on short-term memory and help to focus the student's attention on strategically important aspects of writing. Additionally, these visual algorithms help the student to self-initiate higher-order processes (metacognition) which the novice writing is unlikely to activate without prompting.

Enhanced Communication and "Publishing" Competencies

Authentic tasks in writing education take students through a "critical path" of asking a question, doing an investigation, answering the question, and communicating the results to others. All teachers mentioned the need for an "invention" workspace in the software suite — both for idea collection and for reflection. Equally important was the ability to share drafts and finished products with classmates. Teachers wanted a vehicle for increased sharing among students which would also enhance students' ability to communicate with peers in collaborative work efforts — for example, in providing commentary and accepting constructive criticism. Most teachers reported that the software suite improved abilities to draw inferences and to develop a synthesis out of multiple sources or perspectives and increased tolerance for uncertainty. Students became more adept at pulling things together and "reporting" for a range of audience, purpose, and forms.

Increased Understanding of Relationship between Information Manipulation and Concept Formation

Understanding the "process" of writing means knowing how to extract higher-order meaning from carefully collected data and objectively recorded observations. Teachers helped to author many quantitative and qualitative activities in R-WISE to encourage students to see the meaningful trends observations and to use this information for such sophisticated cognition as prediction, explanatory generalization, or decision-making.

As a direct result of our teachers' advice, R-WISE was given interfaces that model explicit, strategic intellectual processes so that the fledgling student avoids what Collins and Gentner (1980) have termed "downsliding," or becoming increasingly entangled in lower and lower levels of mental actions, finally concentrating all attention on such things as spelling, grammar, and sentence construction to the exclusion of larger concerns in the process. Additionally, adaptive instructional statements within the context of a workspace mediate transitions from thoughts to symbolic representations. Students are helped with such mature cognitive activities as discerning patterns in bodies of information, decision-making, staged problem solving, analysis, synthesis, and inferencing.

Using Classrooms as Testbeds for Educational Software

The development cycle for BioBLAST and R-WISE emphasized feedback from teachers. I have reported here on the development cycle and initial field-testing of a pre-release versions of two large software projects. At well-defined intervals, "lessons learned" were incorporated into the next release. This overarching commitment to iterative design and formative evaluation has many benefits:

- Integrating Advanced Media into the Curriculum: Software supplements for teaching/learning cannot be treated as "self-driving" or as "stand alone": advanced technologies must gracefully partner with the aims of the teacher and abilities of the students in order to enhance education. Each of the teacher-leaders in both groups is highly adept at fostering both content and concept learning through skillfully orchestrated classroom practices. The creative ways in which each teacher integrated various components of the software into a meaningful "whole" gave the development staff insights in two categories. First, we made valuable observations on the larger pedagogical issues of embedding advanced media in education. Second, we learned much about the more local issues of bundling the tools, activities, and informational support into engaging, day-to-day lessons.
- Accommodating Self-Directed Learners: As valuable as teacher creativity was in using the software, student usage told us much about mediating learning in a problem-based environment. Of the approximately 12,000 students participating in the R-WISE development and the approximately 800 working with BioBLAST, the majority were intrigued by the subject matter and the approach. (Analysis of data — including results from a pre- and post-test have been reported elsewhere). Observation by teachers and from site visits by the development staff point toward increased student engagement.

Developing new approaches to advanced educational applications always involves a risk. These two projects were especially demanding because of the complexity of the domain, the richness of the items included, and the freedom of choice offered both teacher and student in exploring content and performing tasks. However, through the efforts of a multi-talented team, field testing of both R-WISE and BioBLAST demonstrated the fundamental soundness not only of the software but also of the collaborative approach through which they were built.

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Developing a Customized Teaching Assessment Software Instrument

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Teachers learn a great deal through trial and error. Yet, as we continue to teach, it becomes obvious that planning, organization, student characteristics, progression of skills, social dynamics and other variables are prominent elements in our teaching performance. We must not only be visionary but also analytical in what creates an effective learning environment.

Teachers need to subject themselves not only to periodic self-evaluation, but also to the scrutiny of peers, superiors, and to their students as well. Subjective ratings, anecdotal records, and comments from others are an important part of evaluating teaching effectiveness. However, many of these methods may lack reliability and may not be easily transformed into solutions for a problem area. Systematic evaluations are objective. The objective data created from observation of frequency of events (such as positive feedback or using student names) and duration of activity (such as time on task or opportunities for correct skill practice) contributes a great deal of information about what is actually going on.

Rationale For Developing Customized Software

There are a variety of pencil and paper assessment instruments available for analyzing and evaluating teaching performance. The instructors wanted to share with the students a variety of educational technologies. Therefore, a search for software which facilitates collecting, analyzing, and reporting of observable teaching behaviors was instigated. The advantages of such a computer software program that utilizes objective criteria such as time and frequency enables a person with minimal training to conduct an evaluation of someone's teaching performance. Computerized screen presentations and graphical printouts of a teaching performance would create an immediate and informative awareness of one's teaching behaviors. Simultaneous situations recordings such as time on task and frequency of behaviors could be tracked and transcribed more easily through software technology than by a manual paper-pencil and stop watch operation.

The current software packages available did not address all of our needs. The decision was made to develop our software in a Windows environment. The Windows interface would make the computer program more user friendly than MS-DOS based software available. Our goal was to develop customized teaching analysis software that would accurately measure any recorded various teaching behaviors and communicate useful results quickly to the observed teacher with the goal of improving teacher performance.

Development of *The Evaluator*

Our objective was accomplished by developing a PC computer software program, *The Evaluator* (Henry and Hubbard, 1997), that uses a Windows interface programmed in Visual Basic language. It was designed to effectively measure time on task behaviors as well as frequency of teacher related behaviors. *The Evaluator* allows collection of data for any observable behavior that can be timed, counted or commented on. Specific behaviors to be measured can be determined by the observer prior to actual observation.

Figure 1 shows the opening format. The window has four sections. Each section contains a help portion to assist in performing the functions of that section.

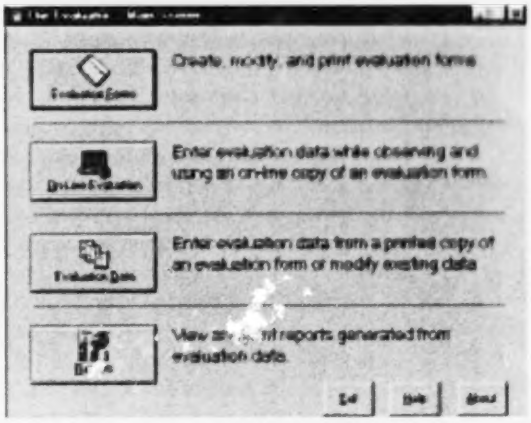

Figure 1. *The Evaluator* Main Screen.

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Evaluation forms. Creates, modifies, and prints evaluation forms.

Online Evaluation. Evaluation data is entered while observing using a developed online copy of an evaluation form.

Evaluation Data. Evaluation data is entered from a printed hard copy of an evaluation form or to modify existing data.

Reports. View and print reports generated from evaluation data in statistical and graphical representation..

Figure 2 shows a form that has been designed in advance to record the specific observations of a teacher's lesson performance.

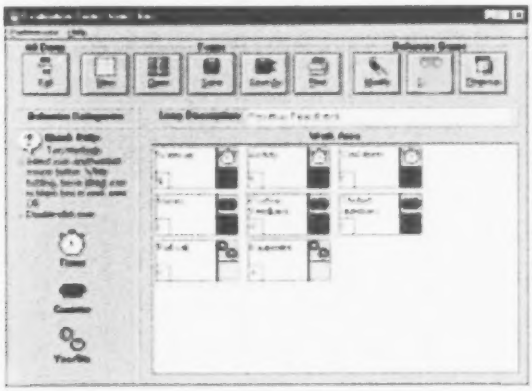

Figure 2. *The Evaluator* Evaluation Form.

This software program can be used with a PC or laptop computer input directly in the classroom/gymnasium or in conjunction with paper/pencil recording with later transfer to the software program using an online form such as figure 2. The program is designed to print reports, charts and graphs for immediate feedback. Figure 3 is an example of a completed evaluation of a teacher's performance. This report was instantly processed and displayed for immediate feedback to that teacher.

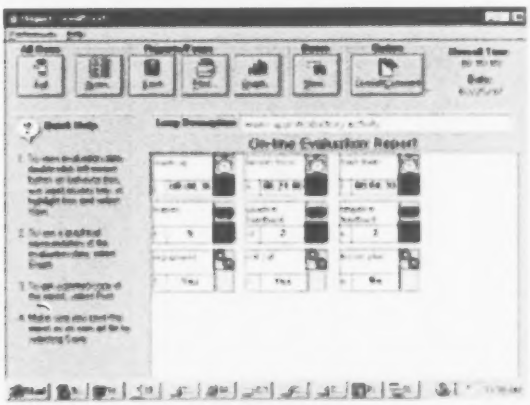

Figure 3. *The Evaluator* Online Completed Evaluation Form.

In addition, figure 4 is a graphical representation of observations recorded in that lesson. Graphics can help a teacher get a better "picture" of how the lesson progressed.

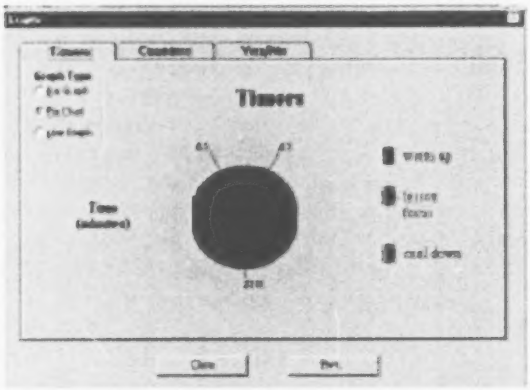

Figure 4. *The Evaluator* Graphic Report.

The advantages of a computer software program that utilizes objective criteria such as time and frequency are obvious. An individual possessing minimal training can conduct an evaluation of another person's performance. The computerized screen presentation and/or printout with a graphical display of a performance are immediate and informative devices which give someone immediate awareness of their teaching behaviors. Simultaneous situations (such as time on task, definitive portions of a lesson - introduction, review, etc.) as well as the time span of those situations can be tracked more easily through the software's technology rather than manually through a person's paper/pencil and stop watch procedures.

Final Thoughts

Evaluators using *The Evaluator* are able to use their time more efficiently, primarily after the evaluation is complete for counseling the individuals. The work is virtually done after the evaluation. All of the reports are generated automatically and immediately by *The Evaluator*. The reports can be graphically demonstrated to allow better understanding. Immediate feedback is the major contributor to behavior change. The immediate feedback of *The Evaluator's* reports increases the likelihood that an evaluation will result in positive behavioral changes. *The Evaluator* can identify specific areas for improvement of individuals being evaluated. The objective accuracy of *The Evaluator* means more confidence in the results and the more likely they will be accepted. As the performance of a person being evaluated improves through the use of *The Evaluator,* the performance levels of others will also improve. *The Evaluator* can also be used to measure time on task and other learning behaviors of teachers. The same benefits of evaluation, immediate feedback and positive behavior change that applies to teachers can also be applied to students. A demonstration version and infor-

mation on the computer software program *The Evaluator*, may be obtained at web site: http://www2.southwind.net/~guerilla or by contacting Guerrilla Software, 6826 East Odessa Ct., Wichita, KS 67226.

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Supporting Planful Teaching: Embedding Instructional Design in Ongoing Assessment

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Starting about four years ago, the University of Arizona began a major initiative to try to reform teaching practice and to rebuild serious scholarly interest in teaching. The central component of this initiative was reform of the general education curriculum, which has now been completed. But an important offshoot of the initiative was a re-examination of teaching and its importance relative to other areas of faculty responsibility. Tenure and post-tenure review procedures were rewritten to weight teaching more heavily in evaluation and to require more documentation of teaching effectiveness and more explicit defense of teaching choices. Workshops and symposia were offered on such instructional designs as cooperative and collaborative learning. Study groups were formed to try to figure out how the university could become more 'student-centered.' Grants were awarded across campus for competitively selected instructional innovation projects. Gradually, the idea spread that there might be a need for change in our routine teaching practices, and much interest began to center on the possibilities presented by the Worldwide Web and other electronic media.

In this changed institutional environment, faculty are becoming much more planful about their teaching but also much more demanding of credible advice about teaching. Urged by instructional designers and information technology specialists to experiment with educational use of the Worldwide Web, faculty raise challenging questions about the value of new technology and about the balance between effort and return. They want to know whether investing in development of materials for the Web will pay off in any sense: whether it will improve learning, and if so, whether the improvement will be substantial enough to compensate for the time invested in development and for resistance from students. Many have heard from colleagues of the frustrations of building elaborate websites for classes that students never visit or, worse, visit but regard as useless.

Even faculty who are intent on improvement are often leery of change. This paper documents an effort to respond to the sometimes paradoxical demands faculty make in these circumstances: demands for tools that make it easy to do new things, and demands that these tools be accompanied by documentation of their effectiveness that can only be obtained after the tools are put to use. Our main strategy has been to try to try to build a learning community among faculty, using an online instructional support system both as a platform for dissemination of new ideas about teaching and learning and as a device for continuous collection of data on strategies and outcomes.

The Support System: POLIS

POLIS stands for "Project for On-Line Instructional Support," and the current version of the system is available on the Worldwide Web both as a production site for University of Arizona courses and as a demonstration site for public use (Jackson, 1996). POLIS is a web course construction kit that lets instructors build a course on the Worldwide Web in any subject, for immediate delivery to students over the Worldwide Web. No special training is required to use POLIS. 75 distinct courses were mounted on POLIS for Fall 1997, despite a complete absence of training programs or advertising. Instructors found the tools through word of mouth, search of the University's website, or direction to POLIS from the University Teaching Center. Most instructors never need assistance of any kind in using the system.

To build a course, the instructor visits a certain website and creates interactive web pages using POLIS resources. The resources include things like student-built bibliography and webliography, support tools for student study groups and student project teams, and several varieties of discussions. Instructors can also upload their own hypertext or multimedia content and link or embed these in POLIS resources, or they can use POLIS tools from within an independently maintained website. Although there is considerable flexibility within POLIS, a beginner can create an entire course without dealing with any of the complexities normally associated with web publishing.

The ease with which POLIS can be used is an important design feature of the system, but it is not the most important feature of POLIS. The most important feature of POLIS is that it allows for creation of highly sophisticated interactive dialogues on any topic, again without requiring any web programming skills. All resources in POLIS, but especially the interactive dialogues, aim for "significant" interaction requiring thought and effort (Milheim, 1995-96), mostly in the form of free verbal resource to questions and arguments.

At present, POLIS offers four well-defined dialogue types (in addition to a general-purpose threaded discussion format). Known as "POLIS lesson protocols," these dialogue types are online simulations of interaction sequences known from prior research to be effective in traditional classroom settings. Each online protocol can be described as a sequence of display and response elements (Jackson & Madison, 1997).

One-Minute Essay. In traditional classroom settings, the one-minute essay involves simply having students write for a very short time on a topic covered in the lecture or discussion, sometimes as a way to develop materials prior to discussion and sometimes to summarize, integrate, or reflect on materials already covered (refs). The online version has two required elements (a prompt and a student response) that can be elaborated with an optional display of student writings, shown before or after the student's own submission. As compared with the inclass version, the online version has two potential advantages: its adaptability for asynchronous interaction and its automatic archiving and publication of student writings.

Recitation. A standard recitation is a question/answer/assessment sequence. Although this familiar protocol has fallen out of favor as constructivist ideas have taken hold, it remains a popular tutorial sequence. The POLIS online recitation has four elements: the question, the student's answer, a "model answer" to which the student's own answer can be compared, and a self-assessment. Like the One-Minute Essay, the Recitation protocol can include optional elements such as display of any amount of background information in text or multimedia, and it can include display of other students' writings at any point in the response sequence. As compared with an inclass recitation, the online version has the advantages mentioned above, plus the advantage of allowing every student to give an independent answer to every question in a set of exercises.

Adversary. Responding to many recent calls for an increased reliance on argumentation in learning, especially in the sciences (Kuhn, 1993; Kuhn, Shaw, & Felton, 1997; Pontecorvo, 1993; Meyer & Woodruff, 1997; Zeidler, 1997), POLIS offers a simulated online debate protocol in which students are invited to stake out positions and defend them against counterarguments written by the instructor or selected from other students' writings. The Adversary protocol's elements are as follows: description of a controversy; student selection of a standpoint and preliminary defense of that standpoint; presentation of an opposing argument; student reaction to opposing argument; and student reconsideration of standpoint and explanation for changing standpoints or standing pat. Any number of opposing arguments can be presented for the student's reaction. The next revision of this protocol will also allow for review of other students' arguments on either side of the issue.

Virtural Peer. Based on Mazur's (1997) ConcepTest protocol, the Virtual Peer is an alternative format for incorporation of argumentation into courses in any subject. Mazur's protocol, as used in traditional classroom settings, has 6 distinct elements: presentation of a problem with a set of candidate answers; silent reflection by students; commitment by each individual student to one of the candidate answers; argumentation among pairs of students trying to convince one another of the correctness of their answers; reconsideration of candidate answers; discussion of the correct solution and reasons why other candidate answers are incorrect. The online version presents the problem with a set of candidate answers; asks for the reasoning leading to the selected answer; presents contradictory reasoning favoring each unchosen alternative and asks how the student would respond to a classmate reasoning in this way; presents the candidate answers for reconsideration and asks for reasoning supporting the student's new answer; and finally presents the correct solution. The online version sacrifices live interaction with peers, but improves on the live version by assuring that every student will have to respond to reasoning that differs from his or her own and by assuring that this reasoning will present significant intellectual challenges.

How POLIS Disseminates Advice About Teaching

When instructors open their lesson composer in POLIS, they are presented with choices among four supported protocols, and along with structural descriptions of each protocol they see a short passage containing "Recommendations." The recommendations give a very short summary of the research basis for the protocol, explaining its origination and whether it has been shown to enhance learning. For example, the recommendations accompanying the Virtual Peer protocol read as follows: "No-tech inclass version has been shown to be very effective in teaching both science concepts and problem-solving. Online version allows for close control over the 'peer' contributions to learning." The recommendations accompanying the One-Minute Essay protocol point out that the contributions of routine writing to learning do not depend on whether an instructor grades each piece of writing.

Instructors come to POLIS as an easy way to create interactive course materials on the web. However, their

actual engagement with POLIS has the potential for more profound and pervasive change in teaching practice, and this potential follows as much from the design of the authoring tools as from the design of the protocols themselves. Two features of the design of the authoring system are significant for the present discussion.

First, the display of four distinct protocols, each described in terms of its display and response elements, draws attention to a more abstract process of lesson planning. The four protocols do not exhaust all of the possible teaching/learning dialogues that can be composed once an instructor begins thinking strategically about forms of interactional engagement. The recommendations draw attention explicitly to the features of each protocol, and more importantly, they draw attention to the possibility of using these protocols in traditional classroom settings as well as in online applications. So the lesson construction tool is not just an authoring tool, but also a learning environment for teachers, a place where they are introduced to a relatively unfamiliar way of thinking about lesson planning that can be assimilated into practice in many ways.

Second, the recommendations emphasize the theoretical and empirical justification for each protocol. The recommendations explain what grounds there are for believing that these protocols will produce effective lessons. The inclusion of a protocol in the POLIS lesson composer is a sort of institutional stamp of approval for the use of these kinds of interactions in teaching. Protocols that have produced negative results in research (Marttunen, 1992) are not supported within POLIS. However, even for protocols that have been included, the stamp of approval is clearly provisional, subject to revision as experience with the online protocols either confirms or contradicts experience using similar protocols in traditional classroom settings. The design of the authoring environment is meant to emphasize that planful teaching has grounding in research and reflection.

POLIS is officially a support system for online instruction, meant to assist instructors in moving coursework onto the web. It should be obvious, however, that the support tools and the learning environment they create have the potential to alter the way instructors plan for face-to-face meetings with their students.

How POLIS Gathers Data on Teaching and Learning

We mentioned earlier that POLIS does not simply disseminate what is currently known about teaching and learning, but also allows us to continuously accumulate data on these processes. Most POLIS data collection is completely unobtrusive. When teachers use the POLIS tools, their activity leaves records in the form of specific objects built for their classes, such as lessons. When students work within POLIS, their activity creates responses archived within the course directory. Both instructors and students generate logs of use and of movements from page to page within a site. Additionally, new quiz and survey tools built within a related system (tentatively known as WILBUR) allow us to gather self-report data of any sort from students and instructors.

The lessons constructed by POLIS instructors and the choices they reflect can be analyzed both quantitatively and qualitatively at any point in time. A search tool designed to allow instructors to locate relevant examples of each dialogue type also allows us to determine how frequently each lesson protocol is being chosen. These can be cross-classified with the type of subject being taught to build knowledge about the fit between protocols and subject matter. For example, the Virtual Peer is modelled explicitly after a protocol developed for the teaching of physics, but it is by no means limited to that field and has yet to be used in a science course at the University of Arizona. It has, on the other hand, been used extensively in social science courses, and it could be adapted to courses in any area. We can also examine the content of the protocols for internal evidence that instructors are attempting to appropriate the structures for other than their intended purposes. We found early on that instructors in some fields were using the One-Minute Essay framework to post announcements and assignments, setting the number of prompts to "0" to suppress the production of a student response page. In effect, this means that instructors *chose* to make their web resources noninteractive. To discourage this way of using the protocols, we added separate tools for posting assignments and announcements, but we have not yet been successful in getting instructors in math and science fields to use online writing to support learning.

Student responses and logs function similarly as sources of data. By examining and content analyzing student writings, we can recover surprising information on how students orient to the various features of the protocols. For example, we have discovered simply by examining automatically generated archives and logs that our original design for the Recitation protocol has the unintended effect of making the "model answer" seem to be the point of the lesson. Stripped down to its structural minimum, a recitation has three required elements: a question, a candidate answer, and an evaluation. Our online implementation of the recitation originally consisted of these three elements, with the answer taken as open-ended essay and the evaluation offered as a "model answer" returned when the students submitted their answers. In many situations, getting the "right" answer is of relatively little importance compared with having a chance to compare a candidate answer with an expert model.

Unfortunately, we have found through examination of logs generated as byproducts of the students' activity that they routinely skip to the model answer before giving their

own answer. Checking input to be sure the student has made an answer is useless, since students can simply enter a nonsense string. Adding a fourth step to the protocol in which students are asked for their reaction to the comparison of their own answer to the model has also done nothing to fix this defect: students who have simply copied the model answer into the response space will assert proudly that their answers were "exactly right," since they matched the model exactly. The lesson they are learning is "exactly wrong," of course, and knowing this, we can tinker with the protocol to try to prevent it.

Although surprising amounts of information can be recovered unobtrusively, from records generated automatically as byproducts of teaching and learning, we do also gather data systematically and overtly using online surveys and questionnaires. POLIS went into production in Fall 1996. By Spring 1997 we had an end-of-semester questionnaire for instructors to complete, reporting on their experience with POLIS. Unfortunately, the number of courses using the system was still rather small, and among these the response rate to the survey was low. Consequently, we learned relatively little from these questionnaires compared to what we learned from the unobtrusive data. Much of what we learned from the questionnaire data could have been learned from direct examination of usage data: for example, instructors gravitated first to the information tools (webliography and bibliography), overlooking entirely the powerful interactive capabilities of POLIS. Not surprisingly, instructors found it easiest to adopt the "stage one" tools that closely resemble their prior teaching practices than the "stage two" tools that attempt to induce new practices (Hall, 1993). Survey data from Fall 1997 are not available at this time, but even without survey data a trend toward increasing use of the dialogue and discussion tools is evident.

Assessment and database tools being introduced for Spring 1998 as part of the WILBUR initiative will greatly expand our ability to evaluate impact on student outcomes. These tools will enrich the authoring environment by adding the capability of building quizzes, tests, and surveys for courses and other uses, and by linking data drawn from responses to these instruments to POLIS archives and to other information systems. As with the current data sources in POLIS, these assessment tools will generate data as byproducts of teaching and learning. For example, a quiz used to assess a student's comprehension of the material contained in an online lesson will serve secondarily to help us evaluate the effectiveness of the lesson design.

Conclusion

POLIS was designed to make teaching on the web as easy as possible and to work well within the ordinary preparation and planning practices of teachers. The authoring tools are available to instructors 24 hours a day from any point of access to the Internet, and they make instructors completely autonomous web publishers, independent of consultants, network administrators, programmers, or other support staff. Ease of use and ubiquitous availability to the instructor is crucial to the usefulness of the system as a platform for disseminating current knowledge about teaching and learning and as a device for gathering new data on what works.

Instructors come to POLIS for the authoring tools; but in using the tools they learn about new teaching strategies and they contribute information automatically that helps refine our knowledge about teaching practice and learner outcomes. Students come to POLIS for the lessons and other resources; but in doing their work they too contribute data that we use for evaluation of the tools themselves. This interweaving of instructional support and instructional assessment allows us to build a self-correcting system whose development directions emerge constantly from examination of teaching practices and learning outcomes.

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WeSaySo Case Study: Designing and Implementing a Case Study for Use in an Instructional Design Class

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Before the design process could begin it was imperative that the group set goals and define its own purpose for composing a case study. The group's intent was to write a case study to aid graduate students' understanding of the purposes and use of a needs analysis. Students were to use the case study to enhance their understanding of instructional design. Because the case study was for an IT class, it was decided that a web presence would be the best way to deliver the project. As a group, it was determined that a case study would provide the best medium to help students develop a better understanding of the steps involved in designing, analyzing and implementing an effective needs analysis. The case would involve real events at a fictitious cc.npany. The process of gaining insight into the characters and company would help facilitate the students' ability to process classroom lecture and text. It was thought that the case study would affirm the progress of the students as they formulated answers to given case materials. It was expected that active participation with the case study would create an extension of classroom learning.

It was envisioned that the students would combine classroom knowledge of their disciplines and connect this information with the subject of study: the fictional company *WeSaySo Oil and Gas*. This case study was designed to facilitate the transfer of conceptual knowledge to concrete concerns. The use of the case scenario was designed to provide the student with an opportunity to become a constructive problem solver.

Basic Components

The case study was facilitated through a web site, e-mail and a listserv; however, the web site was the primary information source. The listserv and e-mail were used primarily to communicate the discussions of fictitious characters in the case study. Additionally, students were encouraged to join in discussions with the characters. Each team member in the case study took on a persona, so there were three employees of WeSaySo and one training consultant.

The web page consisted of six primary web pages with secondary pages linked to the *Case Study* page. The *Welcome* page and the *Why a Case Study* page were designed to give the instructional design student more information about the rationale for a case study and how to use the WeSaySo case study (screen capture 1).

The primary source of information for the case study was found in the biographical information about the individual characters. Work history, education and other pieces of information helped to define the case study environment (screen capture 2). Additionally, performance appraisals and sound clips helped to add further definition to the environment (screen capture 3).

Once the students were acquainted with the characters, company and problems, the listserv was used to facilitate discussion between the training consultant and employees. An interview process was used to gather information for the need's analysis. Students in the instructional design class were invited to join the discussion (screen capture 4).

After allowing ample time for discussion, the need's analysis went up; this was followed by further discussion, and a final product went up two weeks later (screen capture 5).

In addition to the actual case study, a link page provided other sources of case studies, a timetable page provided a summary of weekly input and progress of the case study, and a contributors page gave information about the participants.

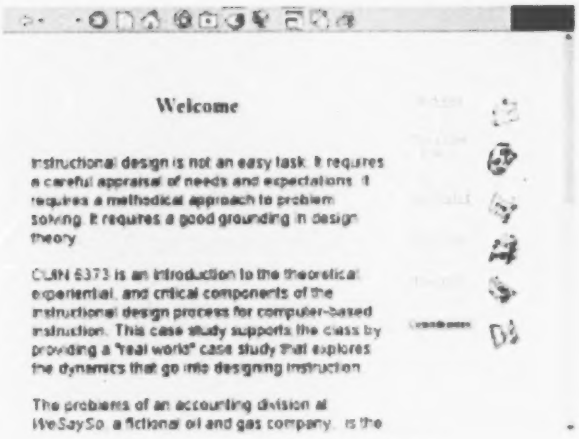
Welcome
Instructional design is not an easy task. It requires a careful appraisal of needs and expectations. It requires a methodical approach to problem solving. It requires a good grounding in design theory.
CUIN 6373 is an introduction to the theoretical, experiential, and critical components of the instructional design process for computer-based instruction. This case study supports the class by providing a "real world" case study that explores the dynamics that go into designing instruction.
The problems of an accounting division at WeSaySo, a fictional oil and gas company, is the

Figure 1: Information Page.

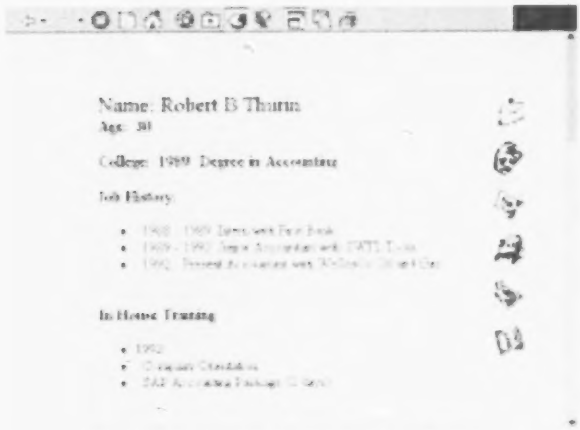

Figure 2: Employee's Work History.

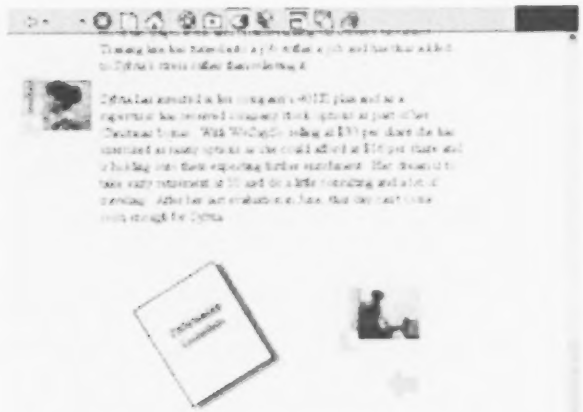

Figure 3: Employee's Work History.

Figure 4: Class List Serv.

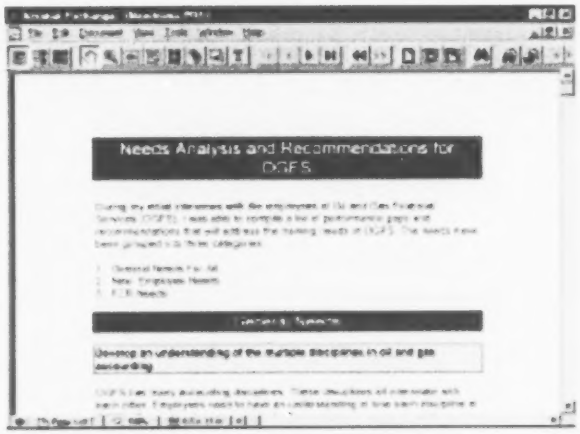

Figure 5: Final Need's Analysis.

Group Dynamics

The four members of the case study preparation group are pursuing masters degrees in Instructional Technology at the University of Houston. We were able to share our classroom learning, unique talents, and work experiences on the project. The combination of our formal learning and work experiences enabled us to develop a fictional case study based on real-life for instructional design.

To facilitate this project we needed to establish parameters for communication. We decided to meet face to face as needed to brainstorm ideas and deliverables as well as discuss our roles and responsibilities to the team. To supplement these meetings we chose to use e-mail as our mode for information and data sharing.

With any group communication can become a problem. For example, e-mail service is unpredictable and information may be misinterpreted. Overall our group was able to take communication mishaps in stride and continue working together to accomplish our goal.

At the initial meeting we were debriefed individually about the case study project. No clear objectives were established, resulting in part of the learning process becoming the creation of learning objectives. At times the group became frustrated. We did not know where to start, what was expected of us, how the final product was to be used, and what was the scope of the project. The scope of the endeavor was overwhelming at the start, yet we were also excited about the opportunity to display our instructional design competencies, develop new competencies and share our experiences with fellow students.

In the early meetings we brainstormed ideas about what was to be accomplished and developed a plan of action. The first concept was to develop two case studies: a business model and an educational model. Two case studies would enable the project to appeal to all the learners in the classroom and demonstrate differences in the instructional design process. We developed individual roles and responsibilities and set out to gather information to share about the case studies. Our initial plan was to take the students through the development of a needs analysis for a business model and continue with the development of a finished product in an educational setting.

Midway through the project some team-member's enthusiasm for the project began to wane. Other factors such as work, school, and personal obstacles intruded on the project. There was also a renewed sense of frustration in trying to complete what had become a broader undertaking than we had first conceived. As a group, we decided to revisit our original vision and modify it to fit the students' needs and our own time constraints. The new vision was to follow through the whole instructional design process using the business model. With our new vision in mind, we set off to accomplish the task with increased excitement.

As the project drew to a close, we discussed housekeeping tasks that needed to be accomplished. These responsibilities included student and instructor evaluations of the project, assessment of the web page, appraisal of the use of the listserv, release of the final deliverables, discussion of what worked well with the project and how could it be improved in the future.

For all of us this was the first time we worked in a group framework that extended over a long period of time. Most of us were familiar with working in a single group for short projects but never over a sixteen week course with everyone depending on each other to accomplish the tasks. There were some communication breakdowns, misinformation, and technology problems encountered throughout the process. However, as group we worked through these and it made us stronger. We all feel that next time we work in a group that will extended over a long period of time we will be better group members.

Benefits to the Class

Using one or more case studies in the curriculum design class has advantages and disadvantages. Several modes of learning were made available to the class, including role-playing, debate, game design, lecture and demonstration, individual and group research, and the online case study. As one of several methods of instruction, the case study could become an important part of the course.

The case study addressed here was a business model involving an accounting department, a situation with which most students in this class would normally be unfamiliar. The advantage of using an unknown circumstance is that this is a position in which a professional training consultant or course designer likely will find himself at some point. It also frees the class from digressing into a discussion of how things are done currently in their own schools or businesses and focuses the class attention on the problems at hand in the case study and how to sol[illegible].

A case [illegible]udy with the writers of the study available for online discussions has exciting possibilities for being a dynamic instructional instrument. Student interaction with the "characters" of the case can increase student interest, allow deeper understanding of curriculum elements, and cause the case study to be different every time it is used. The characters can engage the students in debate, discussion, and allow student comments to alter outcomes. The disadvantages of the use of case studies revolve around the same issues as the advantages. An unfamiliar situation may cause students to have decreased interest in the project due to lack of appeal of the application. If the case does not directly affect a student's particular situation, current or desired, he may have little motivation to examine the ramifications of the case. The online discussion and interactivity with the characters causes the case to have to be developed in "real time" with the class, leading to deadlines being unmet and frustration on the part of the class itself, as well as those working on the case study.

As the curriculum design course is intended as preparation for employment in some kind of training capacity, the use of case studies, both real and fictional, are important parts of the course. A selection of cases already prepared and "in the can," so to speak, may be a solution to the disadvantages enumerated above. The course instructor could select an appropriate case study for a class, and have a group of students who have previously taken the course assume the roles of the characters online. Continued use of case studies will define and refine its role as part of the curriculum design course.

What the Team Learned

In designing a case study it is easier to construct a situation about something which the authors have explicit knowledge and awareness. However, the team agreed that

the instructional design class would benefit more from a study that was distinctly different from their comfort zone of the classroom. The team chose a business model hoping that it would challenge the instructional design class to think outside their world the classroom. However, this decision created additional problems that had not been anticipated.

First, the team had a difficult time constructing a real-world study because it was dealing with accounting concepts within a business model. The model for the case study was an oil and gas company with problems in an accounting department. It was very difficult to construct the case study so that the model was real and credible. The team simply did not have an awareness of the business to make it "feel real." The team enlisted the services of an accountant to help with some of the details; this helped some. A case study can be written about a situation that is foreign to its authors and users; however, it takes extra research into the situation and an awareness that the situation will need to be even more rigorously researched and developed. In the case study of *WeSaySo* memos, dialogues, charts and even a company prospectus could have been used to make *WeSaySo* more realistic. The biographies, sound bites, and performance appraisals that were developed helped to create the context for the case study, but more could have been done.

The team soon came to an awareness that the personalities, experiences, and goals of each team-member were important to the successful completion of the project. The opportunities and challenges of working as a self-directed team helped each of the team members to grow in an understanding of the dynamics of cooperative learning. The members also came to a better understanding of what it is like to be part of a project-team. One team member remarked at the end of the project that this was the first experience that she had ever had in being part of a team.

As part of this team-effort, the four students came to understand that each individual was on the project for different reasons. Different reasons imply different levels of commitment to certain components of the project. These different levels of commitment resulted in a perceived inequity in the sharing of the workload. The four team members discussed this perception of inequity and agreed that the most important result was that the job got done in a professional manner while allowing all members to make a significant contribution. The four members agreed at the project's completion that this was accomplished. However, the team also agreed that many of the problems could have been precluded with better pre-planning and clearer member guidelines.

More lucid guidelines and better planning could mean several things. First, a more formal time schedule with strict rules for adherence should have been considered. Individual goals and team goals could have been discussed and agreed to. Personal contracts between the team members could have been written. Consequences for failing to meet deadlines could have been implemented. Several things could have been done to establish the parameters of personal and group conduct, but it is uncertain that they would have been effective. Because the class was only a three-hour class, and because each student had different personal goals and responsibilities, it may have been difficult to get a group consensus as to what to expect. It would have been even more difficult to enforce the guidelines. Nevertheless, the group still agreed that some form of accountability should have been built into the project plan.

Designing the case study was not an easy task, yet the time spent working through the issues of instructional design helped the team-members to understand the steps of instructional design as well as the steps that go into designing curriculum as a team.

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Designing a Collaborative Multimedia Course: Culture and School Success

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The Final Report of the Indian Nations At Risk Task Force states that, "Our schools have failed to nurture the intellectual development and academic performance of many Native children, as is evident from their high dropout rates and negative attitudes towards school" (U.S. Department of Education 1991, p. 1). Data gathered as a result of this report identified multiple issues regarding the training of teachers, cultural differences in the non-verbal regulation of classroom interaction, culturally appropriate curriculum, and psychoeducational assessment measures and practices (Baer & Bennett, 1987; Gundersen, 1986; Littlebear, 1993; McShane, 1983; Wald, 1996; Wells, 1991). In response to this report and the growing concern in Utah for the educational needs of American Indian students, the Department of Special Education at the University of Utah developed, with the assistance of federal grants, a graduate program designed to prepare teachers to work more effectively with these students.

The graduate program, with a specialization in teaching American Indian students with disabilities, included four graduate level courses offered during summer quarter sessions on the campus of University of Utah. Personnel from Special Education, Educational Studies, Educational Psychology, and Ethnic Studies within the Graduate School of Education at the University of Utah collaborated on conceptualizing the model, defining the components, and operationalizing the priorities into a unified graduate program of study. Faculty involved represented several minority groups, including individuals from two American Indian nations. This collaboration from different educational and cultural perspectives provided essential input and relevancy to the project. As an extension of this project, developers decided to offer a portion of the specialization content via distance education in an effort to reach educators working with Indian students throughout the state. The purpose of this paper is to describe the process of designing a multimedia distance education course entitled Culture and School Success: Teaching American Indians.

Building Support

Project developers applied for and received funding for a curriculum development effort sponsored by the Utah System of Higher Education under a Technology and Distance Education Initiative. Two major outcomes for this project were identified: (1) to educate a minimum of 350 educational professionals per year in their home communities in "best practice interventions" for American Indian children and youth in Utah, and (2) to develop and test an innovative technology enhanced model for curriculum development and distance delivery which included cost effectiveness, longevity, and flexibility in its use.

The course to be developed "Culture and School Success; Teaching American Indians" was conceptualized as a graduate level course that would be available in both pre-service and in-service contexts to educators in both urban and rural/remote parts of Utah. The course content was distilled from the four existing federal grant funded classes that were taught previously by four professors and offered only on campus. The challenge of developing such an inclusive and flexible course to address the needs of American Indian children and youth at risk in Utah was formidable. The circle was chosen as the culturally relevant metaphor for the multimedia course. In many American Indian cultures, the circle represents the balance of life, as all things important to maintaining life fit somewhere on the circle. By touching one part of the circle, all parts are included. It was found that the metaphor used to address the issues of the course also applied to the development process in creating the distance education course. (Herbert, Mayhew, Sebastian, in press).

In the initial proposal it was clear that the project would need extensive technical assistance. Therefore,

support from an instructional design team and resources for multimedia development were built into the proposal. The four faculty members who serve as content specialists were provided with either released time from other course assignments or stipend support. A graduate assistant was selected to help obtain and organize course support materials. Two additional faculty members, also responsible for distance teacher education in the department, completed the project development team.

Together, there are ten individuals with very different backgrounds and experiences directly involved in the development and production of the course. Each person has a different role, responsibility and expertise to contribute to the process. Roles include: distant education specialist, syllabus designer, video producer, world wide web consultant, copyright research specialist and content specialists in the fields of Indian education, special education, educational psychology, and ethnic studies. Coordinating the activities of the design team, particularly at the beginning of the project, became one of the greatest challenges of this project.

Course Design Theory

Multimedia development is an interdisciplinary effort focused around producing the most effective instructional episode for the learner. Media is defined as a means for effecting, conveying or communicating something. By that definition anything used to effect a learners instructional experience is a medium. A multimedia course uses several different types of media to communicate the instructional message.

The various media examples shown in the model (Figure 1) have distinctive advantages and disadvantages in the instructional episode because each appeals to different learning styles. By combining different media we reach a wider variety of learners creating a rich blend of sensory perceptions. The decision on which medium to use where comes from answering the question, "which method makes it most clear what is to be learned, and which does it most interestingly and most economically of time, space, and money"(MacMillan, 1930, p.338)

To effectively decide which medium should convey what message, developers must first start by defining the message. If the instruction only consists of one medium, for example the professor communicating to the students, then chances are the design process for that course could be relatively simple and direct. But when the design involves a team of developers the process becomes more complex.

Participants who come to the multimedia development process come from different cultures, and therefore have different world-views and perspectives in terms of the design, development, production and implementation process. By involving development stakeholders in the design process needs, frustrations and alternative solutions can be addressed. (Carr, 1997). The team needs to come together to develop a shared language to be able to communicate with one another about all aspects of the project. "The design effort must be interdisciplinary in nature. No one person is likely to be a specialist in all media and content areas to be covered in the process of developing a successful course"(DeBloois 1983, cited in Romiszowski, 1986). In order to successfully communicate and produce what you set out to produce, it is essential that the development have a shared vision of the finished product.

Instructional Multimedia Team Design Model

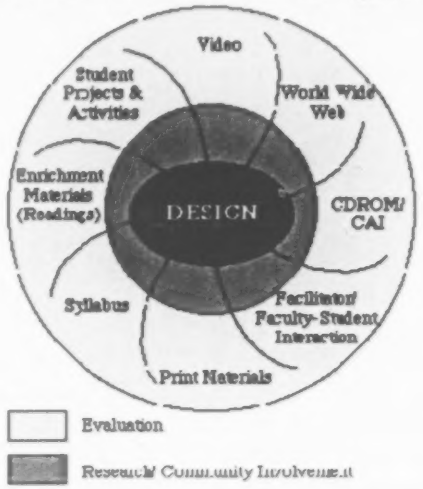

Figure 1: Collaborative Design Model

Unfortunately, many content experts are resistant to this idea, and for good reason. The faculty culture places a high emphasis on ownership for intellectual property, student credit hours and revenues from the completed course. These issues must be answered before the project begins. Regardless of the political landscape for development, the most important pre-requisite for faculty involvement must be the motivation to create an effective instructional environment for the learner. With this as a common denominator among all team members, all other logistical problems are more likely to be solved through effective communication.

The tool for communication in this production process is the instructional design; therefore, it should also be developed collaboratively. Team members' experiences, revelations, and enthusiasm for the project need to mix together through time in order to find solutions to instructional challenges. The successful process allows for that design time. It provides for breathing moments, reflection, and review. It should be a flexible process that always keeps as its focus the ultimate beneficiary, the learner.

However, this process needs to be examined within the context of production timelines, grant funding periods, and academic calendars. Instruction can only benefit the learner if it is implemented; therefore, the team does have to accomplish stages of design, development, and production in a timely manner. To insure that no step is left undone, instructional design systematizes the process but it should not take the creativity and flexibility away from the design team. The process should give the team freedom for creativity by taking away the stresses that comes from last minute production issues.

To assist the design process an instructional designer facilitated a series of large group brainstorming sessions. This person utilized a systematic approach to the design process (Gustafson, Branch, 1997: Romiszowski, 1986) to insure all aspects of the project were thoroughly thought out before the production process could begin. Four stages or levels of design were addressed in designing the course.

Level 1 - Course Parameters

There are potentially as many solutions to a given problem as participants in the design, especially if there is not a clearly defined direction from the start. The first stage of development outlines all of the influencing factors in the course as well as the overall course goal. This helps give the team a common vocabulary to describe the problem and the solutions:

- Who will be taking this course?
- Where will it be taught?
- What technical limitations will the students have?
- Can the material developed for this course be used in any other ways? If so, what ways?
- Why are we offering this course?
- In what specific way will this course meet the challenge?
- How much money do we have to work with?
- When will the course be implemented?

This kind of analysis helps in making the tough decisions of what to include and what to leave out. Many of the issues discussed at this stage are often overlooked because team members assume everyone is starting from the same understanding of the project. However, with such a diverse group of people it is risky to make such assumptions. What may seem trivial now could become a major production problem down the road.

Level 2 -Content

This stage outlines the knowledge, skills and attitudes needed by the learners in order to achieve the overall goal. This includes the assumptions the faculty has about the learners' pre-requisite knowledge and attitudes. The ultimate goal at this level is to define the knowledge gaps between where the students are now and where they need to be after instruction. The definition is stated in the form of learner outcomes. Taken as a whole these outcomes should address all aspects of the ultimate goal of the course.

Level 3- Scaffolding

At this point the team strategizes the best way to meet the learner outcomes defined at level 2. The goal is to chunk the concepts in a way that builds a scaffold of superordinate and subordinate concepts linking prior knowledge to new knowledge. (Peters ,1996: Pressley, McCormick, 1995) Then the team needs to decide what is the most effective way to achieve those outcomes by deciding which medium will best address the concept while keeping the learner engaged and motivated in the process. This is done by reviewing the strengths and weaknesses of the media choices.

Another factor influencing media selection is the possibility of re-purposing the developed media for other projects. Production costs can be expensive. If a product can be used in different ways, the impact of the product is increased and the relative production cost is more efficient. By exploring other possible uses at this early stage, copyright clearances and agreements can be obtained.

Level 4 - Media Element Design

Once the team has developed a more specific list of its media production needs, it becomes easier to determine what already exists and what needs to be produced. Complete segments may already exist thus saving valuable production time and money. This production outline also facilitates more involvement from the community in finding resources for the production. At this stage the team sets realistic expectations about production time line and costs. The team also identifies subject matter experts for each produced element and assigns those elements to a faculty member who will serve as the production team's contact point. However, it is important for one faculty member to be the point person or project leader as faculty is more likely to accept direction from an another faculty member.

Course Design Practice

While the process can be viewed in stages it is by no means linear. With a diverse team, it is important to take a more iterative approach to the process, allowing the team to construct and deconstruct the design. In developing "Culture and School Success", the faculty team met first without the rest of the design team to flesh out the content areas that needed to be addressed within the course. The request for proposal process helped to define many of the issues addressed at level one.

When the design team met, the instructional design facilitator took each of the chunks of content brainstormed by the faculty and worked with the entire team to develop the knowledge, skills, attitudes, pre-requisite knowledge

and assumptions about the learners. From this point the team arrived at the outcomes for the course.

The course content chunks were also pulled into a sequence by the team. In order to illustrate these sequences, lists were put up on walls to help the group visualize the structure of the course. As outcomes were developed, the sequence was reorganized in a manner that best met the scaffolding needs of the instruction. This scaffolding had to fit within the confines of the University imposed semester system, 15 two-hour sessions.

Within each session, the team decided to mix the media based on which medium would best communicate the desired message to the learner. The team wanted to develop an interactive structure that presented a concept or event via video and then utilize break out activities to engage the learner. The purpose of break out activities is to allow the learner to create meaningful concrete experiences for him or herself about the abstract concept covered in the video module. This design follows the "Professor Plus" model extensively used in the rural, distance education program of the Department of Special Education at the University of Utah. (Sebastian, Egan, Welch, &Page, 1996). Enrichment activities, readings and other outside the class events are designed to reinforce the instruction.

Themes developed during this process transcend the individual outcomes. These themes were used in each session to guide the class design. The themes include:

- Historical Context - to set the information in a framework and to call attention to the purpose of the session.
- Self-reflection -to personalize the material, bringing it into the students lives to increase relevancy.
- Student designed solutions - to put a positive slant on the material, helping the students build confidence in developing class based solutions.
- Evaluation - to provide opportunities to track student performance and reward successful achievement.

These themes also have the added benefit of following the ARCS model of attention, relevance, confidence and satisfaction, a method developed by John Keller for improving the motivational appeal of instructional materials (Keller, 1987).

The design was developed over a period of two months for a total of eight all day meetings. Because of outside commitments, not all of the design team participated in each meeting. This meant that throughout the process the team would go back and evaluate what happened at the last session, deconstructing and reconstructing the work. This was especially true when the team started developing the design for individual class sessions. Often members of the team would want to go back to review the content or to the learner analysis when starting a new session design. It was sometimes difficult for the faculty to let go of a specific content area to move on in the course. By keeping the work done to date visible to the team via white boards and paper post-ups, the faculty could be reminded of content already covered which helped to keep the team on track.

The end result was an outline (Table 1) that lists the elements to be covered in each session. Each element includes the amount of time allowed for the element, the presentation style, and the content to be covered, and which faculty members will serve as the subject matter expert for that element.

Table 1.
Example of one class session design

Session 4- Culture: effects in the classroom

Purpose:

Develop strategies to accommodate different communication and cultural styles in the classroom.

Outline:

RT	Presentation Style	Content	Faculty Contact
10:00	Facilitator	Welcome, review	Michael
10:00	Video/ case study	typical class session/ Monument Valley	Michael
10:00	Facilitated Break Out	Analysis	Michael
5:00	Video/ Role play	Communication non-ex.	Nola
10:00	Breakout	Identify what didn't work	Nola
5:00	Video/ Role play	Example	Nola
5:00	Break out	Discuss, set up next video	Nola, Jack
10:00	Video/Role play	Child rearing compare & contrast Indian and Anglo	Jack
15:00	Breakout	Small group, discussion: impact on class	Jack
10:00	Video/ case study	Review typical class session Monument Valley w/teacher interviews	Michael
10:00	Breakout/ Action Plan	Structure class to meet dif. com. and cultural styles.	Michael
10:00	Facilitator	Wrap/ Set up next week	Michael

Total instruction time: 110 minutes

The next step

This account only describes phase one of the long involved process of multimedia course design, but arguably it is the most important step. From here the

various development teams will produce the video elements, develop the print materials, research the enrichment activities, train the facilitators, explore possible world wide web interactions, and design the student activities and projects.

It is at this point that the design team took advantage of the vast community resources available. Given the fact that the course being developed addresses the needs of an under-represented segment of the community it was seen as particularly important to solicit community involvement. An advisory board made up of leaders in the field of American Indian education, school district personnel, families, and tribal representatives was identified to provide additional assistance with the course content and help in the identification of resources. The design team felt very strongly that regular interaction with the advisory board would also be important for the quality and integrity of the course. Because the needs and expectations of the project have been articulated through the design process, the team has been able to solicit input on the specific research needs from this advisory board.

Lessons Learned

There are several lessons the team either brought to the process or picked up along the way. These include:

- Complete the design process before you start the production process.
- Take advantage of the community and culture around you as information resources.
- Formatively and summatively evaluate the project based on the design.
- Look for possible re-purposing opportunities before production starts.
- Be flexible.
- Don't assume anything.
- Provide food at group meeting sessions. (If you feed them, they will come.)
- Faculty who are intrinsically motivated to develop a more effective instructional product will more likely to stick with the entire development process.

The goal of "Culture and School Success" is to promote cultural pluralism in the classroom. Multimedia course development also merges vastly different cultures in an interdependent process that crosses several disciplines. Our final lessons, therefore, have been adapted from the outcomes of the course:

- Celebrate the diversity that comes from different fields of expertise.
- Respect all members of the development team.
- Allow yourself to think outside the box when it comes to changing the way you approach course development.
- Believe and trust in yourself and in your teammates.
- Above all, approach the process from the perspective of what's best for the learner not the development team.

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Using Hypermedia: Effects of Prior Knowledge and Goal Strength

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The study reported here was an interview study of low and high prior knowledge students with strong or weak goals exploring a hypertext stack. We examined the influences of a student's prior knowledge and desired goal on the difficulties and benefits associated with using hypertext. In-depth interviews were conducted with students who participated in the study.

A commonly recognized difficulty with hypertext is the possibility of getting lost or disoriented (Conklin, 1987; Edwards & Hardman, 1989; Hammond & Allison, 1989). This kind of disorientation often occurs when a user suffers from cognitive overload as a result of being confronted with a mass of links through which to navigate with little structural support (Giril & Luk, 1992).

Akanabi and Dwyer (1989) noted the importance of prior knowledge over text structure as students with varying levels of prior knowledge benefited from different types of text structure. Students with high prior knowledge profited most from a less structured, inductive learning environment while low prior knowledge students benefited most from a more structured, deductive environment. Similar results were found by Pazzini (1991) who showed that the rate of concept learning was affected more by students' prior knowledge than by a text's content structure. In general, prior knowledge can determine how well a learner acquires information from hypermedia since it can supply a mental framework, providing both perspective and context for new and inter-connected concepts, allowing a learner to fill in gaps in knowledge. Prior knowledge allows a learner to focus more directly on information presented by reducing the amount of overhead associated with the task of navigating through hypermedia. Without some kind of mental map of the material already in place, working memory can become overloaded as a user tries to understand all the information presented and how it is structured.

Alexander, Kulikowich, and Jetton (1994) concluded that it is important to consider how additional factors other than prior knowledge affect learners. One such factor is the goals that learners have. With many options available in a hypertext structure and all possible avenues equally available, students' goals must play an important part in the ease and effectiveness with which hypertext is used. In an ideal constructivist environment, hypermedia users would search for complex information to meet their own goals (Jonassen & Wang, 1993). However, external goals are often imposed on learners and even when the learners accept such goals, they may not have appropriate strategies available to them to attain the goals.

While goals and prior knowledge have been shown to affect linear text processing, very little research has been conducted on how these factors affect learners in a hypermedia environment. Because these factors have not been carefully considered in relation to hypermedia learning, research is still at the stage where rich descriptions are necessary in order to identify and explore relevant factors. Utilizing a qualitative methodology and small sample size, this study examined the influences of a user's prior knowledge and desired goal on the difficulties and benefits associated with hypermedia.

Method

Participants. Twelve subjects from an undergraduate course in Educational Psychology were recruited to participate in the study. Eight were female and four were male.

Materials. The study utilized a hierarchically structured hypermedia system, SKEIM, developed by A. Kelly (Kelly, 1993; Kelly & O'Donnell, 1994) which runs on the Macintosh platform and was developed using HyperCard Software. The program's content, organized by A. O'Donnell, contains material based on an undergraduate course in educational psychology on the subject of tests and measurement. Concepts were characterized using the sets of relationships identified by Dansereau and his colleagues (e.g., Holley & Dansereau, 1984). This classification of concepts was instantiated within SKEIM and was meant to provide an extra measure of structure and support for hypertext users. Students' performance while using the system was automatically collected by the program in the

form of a trace. The data collected in the trace recorded the student's review strategies by choice of theme, concepts searched, level of detail of the information accessed, and relationships among concepts. Traces contained data on theme, card name, level of depth for card, and time spent on card Material in SKEIM is linked together in a hierarchical structure, which can help users avoid some of the navigational issues associated with hypertext (Girill & Luk, 1992). Using SKEIM requires a user to begin at the highest level of detail for a theme, and through the use of pop-up menus, browse through several levels of detail about the theme; the deeper a student browses, the more detail about the topic is encountered. For example, if a user decided to explore the topic of frequency distribution, she would be presented with a pop-up menu and would then have to choose one of the following: Example, Characteristic, Leads to, Analogy, Part of, Type of, or Definition. In all, SKEIM contained 5 themes and 82 subtopics distributed through nine levels of depth.

Procedure. Participants varied in prior knowledge of the program's content and were assigned to either the low or high prior knowledge category. Within the high and low prior knowledge groups, subjects were randomly separated into two sub-groups: strong and weak accomplishment goals. Students in the strong goal group were given a specific task to complete. They were required to fill in partially completed sentences found in the hypertext database. Students in the weak goal group were given a non-specific task. They were asked to review the material in the system, and told they would be asked questions about the material when they where done.

Each student was shown how to use the program and then given his/her specific or non-specific goal to accomplish. Students were allowed to browse through the SKEIM program uninterrupted for approximately forty minutes. After the student completed the task, he/she was interviewed for approximately forty-five minutes. In order to gain insight into the students' thought processes while using the system, the researcher interviewed students using an interview guide approach.

The first part of the interview involved questions related to the subjects' feelings about use of the program in general: In what ways was navigation difficult or simple, what kind of strategy did they use, etc. Students were then shown every step they made during their use of SKEIM; this was reenacted by the program in a sort of slide show and students had the opportunity to reflect on their activity. At branching points which represented a shift in topics, the researcher asked questions to try and gain understanding about the student's immediate goal or purpose, if any, as well as any reflections on cognitive and met-cognitive activity relating to the branching decision

Results

Prior Knowledge

Students falling in the low prior knowledge category tended to find the system difficult to use. The most common complaint was in terms of navigation, especially in reference to getting lost in the system. Several students claimed that the farther they went into the program, the more they felt lost; the more details they encountered, the harder it was to maintain a navigational model. Students with prior knowledge were comfortable in navigating. Several students wanted a faster, more efficient way to navigate and none complained about feeling lost or in need of assistance while using the program. Whereas the low prior knowledge students complained about the structure of the content being different from their own, the high prior knowledge students all reported that the material was exactly what they expected; none felt their prior knowledge interfered with searching but rather made navigation simple. In response to questions about navigation, almost all felt they were able to find what they wanted easily and keep a model of the program in mind.

One seemingly beneficial aspect of a hypermedia system such as SKEIM is the presentation of a highly structured and organized set of information. For the high prior knowledge students, this characteristic was always helpful since these students already had mental models of the content but not to low prior knowledge students. Several students reported conflicts between their understanding of the content and that presented in the program. In describing her strategy during a certain part of her trace, Laurie noted:

When I thought I knew what to expect, it usually turned out different than I expected – and that threw me off. I had preconceived notions about the grades topic – I expected material about "A's, B's, and C's" but instead found information about frequency distributions, mean, and mode instead.

Another possible problem with providing a highly structured learning environment is that there is less incentive for students to organize material on their own. Students who do not actively participate in learning activities will not benefit as much as those who do (Phye, 1997). Benny felt that the content is SKEIM was: "...organized in a way that made it seem structured – I didn't have to structure it myself. I actually would rather have created my own structure since I wanted the material organized differently."

Goals and Prior Knowledge

Students with little prior knowledge and weak goals were extremely frustrated and anxious. They followed the structure of the stack but were unsure of their actions. When low prior knowledge students had strong goals, they could not find the information they needed as they were

lacking in a conceptual model. High prior knowledge students had little difficulty and in the weak goal condition, they meandered at will in a somewhat random manner. Students in the strong goal group experienced more navigational problems. Students with little familiarity of the material found the task extremely difficult, used poorly defined strategies, and became quite frustrated. Students with higher prior knowledge were better able to perform the task, had only slightly better strategies, and were much less likely to become frustrated.

Low prior knowledge students tended to go through the material methodically, in the order it was presented. This was especially true of those students who had weak goals. High prior knowledge tended to bounce around looking to fill in gaps in their knowledge.

If I was seeing something for the first time, I didn't go too deep into detail but tried to get a more general idea. I was afraid that if I went too deep I would loose sight of what I had just learned. [Laurie]

Laurie's methodical strategy is illustrated in Table1 which contains a list of all possible nodes in the Test Scores theme, the depth for each node, and the relative order that Laurie traversed the nodes. Laurie claimed that she was extremely unfamiliar with the test scores topic, and as Table 1 reveals, she visited most of the cards in that theme and navigated basically in the order presented by the system.

Unlike the novice students, the high prior knowledge group performed the weak goal task in a fairly non-methodical manner. Their strategy, although not haphazard, was much more unpredictable. The students tended to search out of order looking for material that was either new or of interest. This tactic, however, only pertained to material that was familiar. When the students discovered new material, their strategy changed, appearing similar to the novice users' as they searched in an orderly and thorough fashion:

I usually tried to start with a topic less familiar and then went through it carefully. I realized I knew most of the material in the program so I tried to find topics I hadn't already seen. [Cory]

The trace data in Table 2, a section of the Test Types theme, reveals some of the behavior described by the students. Both Cory and Jamie visited nodes sporadically and out of order, revisiting a few nodes after exploring other topics. Danielle's behavior in this section does not match the expected high prior knowledge strategy displayed by Cory and Jamie but rather is more indicative of a low prior knowledge student; she visited the nodes in this section basically in order and thoroughly.

In general, subjects with high prior knowledge were better able to take advantage of the program's assets since for most topics, they were not learning the subject for the first time. They were able to search for new and interesting information without the fear of navigational difficulties and generally seemed more enthusiastic and encouraged by their experiences.

Table 1.
Trace Data of The Test Scores Section of Laurie's Performance

L	Theme	Topic	Link Type	Traversal Order
3	Test Scores	Standard Scores	Type of	32
3	Test Scores	Standard Scores	Characteristics	31
3	Test Scores	Standard Scores	Definition	30
4	Test Scores	Grade Equivalents	Example	29
3	Test Scores	Grade Equivalents	Characteristics	27
3	Test Scores	Grade Equivalents	Leads to	28
3	Test Scores	Grade Equivalents	Definition	26
3	Test Scores	Percentile Ranks	Leads to	
3	Test Scores	Percentile Ranks	Definition	25
4	Test Scores	Stanines	Characteristics	39
4	Test Scores	Stanines	Definition	38
4	Test Scores	T Scores	Example	
4	Test Scores	T Scores	Leads to	37
4	Test Scores	T Scores	Characteristics	36
4	Test Scores	T Scores	Definition	35
4	Test Scores	Z Scores	Example	
4	Test Scores	Z Scores	Leads to	
4	Test Scores	Z Scores	Characteristics	34
4	Test Scores	Z Scores	Definition	33
4	Test Scores	Interpret Percentiles	Example	

When questioned as to why they followed such a thorough strategy, the students explained in terms of their low prior knowledge; they generally had poor cognitive models of the material and as a result followed the model or structure presented to them by the program. This strategy was adaptive since by following the program's model, there was less cognitive overhead related to navigational factors therefore reducing the risk of getting lost.

Discussion

The study considered the influences of prior knowledge and goal specificity, focusing on students' search strategies and navigation styles but also considering students' affect toward the hypertext learning experience. The ability to trace students' search behavior can provide valuable information about the learning process. By conducting in-depth interviews, we were able to investigate some of the affective as well as cognitive reactions to non-linear text processing. Results show that students tended to have more than just a cognitive reaction when learning from hypertext. High levels of anxiety were common for the low prior knowledge students especially when they were required to perform a specific learning task. The implications to these findings are that hypermedia design aspects, which in interaction with specific individual characteristics

such as prior knowledge and goals, can promote negative affect which is known to be non-productive for learning.

Table 2.
Trace Data Of The Test Types Section For The Three High Prior Knowledge/Weak Goal Students for Theme "Test Types".

L	Topic	Link Type	Traversal Order		
			D	C	J
4	Criterion-Referenced	Characteristics	37		
4	Criterion-Referenced	Example	38		24
4	Criterion-Referenced	Leads to			
4	Criterion-Referenced	Definition	36		21
4	Norm-referenced	Example	35		
4	Norm-referenced	Characteristics	34		
4	Norm-referenced	Leads to	33		
4	Norm-referenced	Definition	32		
4	Achievement tests	Example			22
4	Achievement tests	Type of	31		20
4	Achievement tests	Characteristics	30		23
4	Achievement tests	Definition	29		19
4	Standardized tests	Characteristics	24		
4	Standardized tests	Example	39		
5	Uniform Conditions	Characteristics	26		
5	Uniform Conditions	Example			
5	Uniform Conditions	Leads to	27		
5	Uniform Conditions	Definition	25		
5	Essay Tests	Characteristics	47	3	6
5	Aptitude Tests	Characteristics			
5	Aptitude Tests	Definition	28		18
5	Multiple Choice	Characteristics	44	19	
5	True False	Characteristics		17	
5	Multiple Choice	Leads to		22	
5	Multiple Choice	Part of	43	18	

This study contributes to the previous literature by considering how learning goals affect hypermedia users. The results of this study suggest a relationship between subjects' level of prior knowledge and desired goal. This relationship was most noticeable in relation to students' search strategies and navigational styles. The low prior knowledge students performing the strong goal task had complaints about navigation and generally stated that they would have benefited from the use of a navigational aid. In general, they were unsuccessful at their task, suffering more seriously as a result of cognitive overload, frustration, and poor ability to navigate than did those novices simply wandering through the system. The high prior knowledge students suffered much less from negative affect and were somewhat more successful at completing the strong goal task. The task was easier for these students since they already had a mental model of the content and had some idea where to look for an answer.

These findings suggest that developers of educational software should seriously consider features of the audience before committing to a method of instructional delivery. A system designed to teach novices might be more effective if it used techniques geared toward introducing students to a subject rather than a hypertext format. In general, hypermedia systems should be designed to accommodate users of different levels of prior knowledge. A hypermedia system designed for an audience varying in subject expertise should provide as many resources as possible, since novices will probably require them and experts might benefit from their presence.

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Instructional Design Network Project: Using Technolog for Curriculum Design

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The Instructional Design Network Project was an Educate America Act Grant for $158,000 designed to support local school improvement initiatives in Kansas through utilizing technology to assist in developing instruction design specialists. The grant was aimed at meeting goal 4 of the Educate America Act, "...helping the Nation's teaching force have access to programs for the continued improvement of their professional skills and the opportunity to acquire the knowledge and skills needed to instruct and prepare all American students for the next century."

Approximately 41 personnel from 14 school districts were involved along with 11 academy staff members. The project involved three two-day workshops, contact via an electronic mail listserv, newsletters, and a project webpage. The focus was on utilizing technology in the instructional design process and each team was also given skills to enable them to work with staff development at a district level.

Need

The districts selected for the project already had strong academic governance programs regarding curricular instruction. However, there was a great need for training in the systematic design of instruction that aligns with curricular outcomes. There was also a high degree of need to both include technology in the new high performance outcomes and in utilizing technology in developing the program. It was also found that school districts needed instruction in utilizing authentic assessment with school curricula. Thus, the project centered on supporting local school initiatives through using technology to design effective instructional curricula.

Goal

The goal of the project was to create a school/university/business partnership and system for developing and improving the skills of public school teachers in designing and executing performance based instruction.

Objectives

Specific objectives of the project were to: 1) create cadres of instructional design specialists in a network of schools districts located in all regions of Kansas, 2) create a field academy for instructional design at Emporia State University, 3) use the academy to train and support the instructional design specialists in both curricular reform and utilizing technology, 4) provide a means for specialists to work closely with their district or school's academic program governance unit, and 5) provide a means for specialists to work closely with designated businesses in their communities to address business interests and cooperate on community resources.

Activities

Training activities employed strategies that ranged from peer coaching to comprehensive workshops. The workshops focused on 1) academic decision making, the design down system for preparing, implementing and managing curriculum and instruction, 3) the development and use of print and electronic media including writing web pages and development of electronic portfolios for assessment, 4) recommended uses of interactive media, including interactive TV and the Internet, 5) planning and conducting faculty development programs within a district, 6) the relationship between clear instructional design media and acquired funding from business and other potentially supportive organizations, and 8) establishing a national network, primarily through the Internet.

To facilitate the implementation of the grant the IDN Project Council was formed. The council consisted of 13 members, 11 participants and 2 additional district personnel. The Project Council provided continual input to the Academy Staff and had a major role in meeting overall school district needs. An Executive Council was also created with 5 members who approved budgetary items and set major policy for the project. Both Councils met separately from the Academies and most meetings were held in Salina, Kansas.

Three Instructional Design Network Academies were held on two weekends as well as three full days in June when schools were out of session. The academies focused on design considerations, technology, and train the trainer. All of the Academies were held in Visser Hall, the primary

home of the Teachers College at Emporia State University, Emporia, Kansas. Three of the computer laboratories in the Teachers College were used almost continually during the Academies, further evidence of the integration of technology into the curriculum design process.

Academy Staff and Participants

The staff consisted of personnel with considerable expertise in curriculum design, staff development, curriculum leadership, K-12 subject areas, and instructional technology. Of the 11 staff members, 6 were professors with doctorates who were employed at Emporia State University and 6 were affiliated with the Curriculum Leadership Institute. The 41 participants were from 13 public school districts and 1 parochial school, the Catholic Diocese of Wichita. The school districts were from widely scattered counties in the North, West, and East Central areas in the state as shown in Figure 1. The participants were selected from full time teachers, professional support persons, or administrators. They were curriculum leaders and were to possess skills in educational technology.

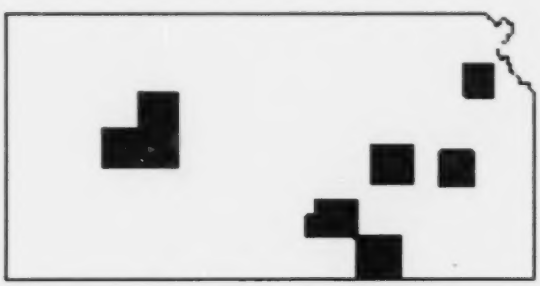

Figure 1. School District Counties on Kansas map

Technology Components

An early assessment of each district's Internet capability found that only three districts had access, and of those, two had connections only in the library. While few districts had access, most were "working on it." However, of the academy personnel, each already had an individual electronic mail account and full Internet access. Thus, while some technology was available in each district, most had only read about the capabilities of worldwide communications and the easy access to information for both teachers and students.

At the very first Academy participants were paired and were given minimal instruction in using Netscape Navigator before being assigned to accomplish a student-level objective. The teams then used the Internet to obtain information, synthesize the results, and then report their findings. The assignment quickly showed the participants the importance of technology to students and also that many teachers and administrators needed additional skills in this area.

The class "Internet Resources and Tools for Educators" is regularly offered by Emporia State University entirely through the world wide web by the author. To enhance the project participants expertise in the Internet, they were offered the opportunity to take the class without paying a fee. While only one person elected this route, 7 went ahead and paid the university fee so that they could obtain graduate credit for the course.

Another technology tool used was establishing a listserv, IDNGRANT@LIST.EMPORIA.EDU. They were then instructed in both using electronic mail and subscribing to a listserv. The listserv was very useful for communications between participants and the Academy Staff. However, since many participants were not comfortable with electronic mail it proved to be of most use to the staff.

A webpage was constructed for the project and many participants had the opportunity to distribute material via the webpage. Participants were also given the chance to learn basic web construction using Netscape Navigator Gold. Additional training was provided in Microsoft PowerPoint, and it proved to be most popular among the software tools. Indeed, when groups from the districts presented their District Action Plan, almost everyone had either transparencies created with PowerPoint or used a video projector and a computer in their presentation.

Outcomes

The primary outcome of the project was to develop or improve the skills of inservice teachers in designing and executing performance and technology based instruction. This would include all teachers in participating districts and on selected surrounding districts. The second outcome was to develop stronger relationships between the local educational and business communities.

Conclusions

The project evaluators felt that the major goals of the project were met. Instructional Design Specialists were developed for each participating school district. However, there was some evidence that the project tried to do "too much," and it was also felt that each component could have had more depth. Many participants wanted considerably more skill development in using technology, especially with the advent of the Internet and its many implications to curriculum at all levels.

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Breakdown into the Virtual: User-involved Design, and Learning

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Science has been changing rapidly over the last decade. Like everything else around us it seems to be in a turmoil of altering, mutating, or disappearing. Most likely the idea of *change* is a cultural phenomenon, and could be seen as a side effect of the 'strange attraction' the media have invoked upon us. Chaos and all of the modern self organizing hocus pocus are splattered all over popular interpretations of phenomena too complex to talk about.

How Hard is the Science?

One of the distinguishing factors in all this may be the evolution of computer science, realizing its potentiality of calculation, representation, and symbolization. This goes beyond the mere superficial digitalization of all scientific data, of the analyses programs, and the evaluation and the dissemination of results. Suddenly a bunch of people grew weary with the way things were going, they strapped together a couple of simple hypotheses and started to advocate controversial views to quintessential theories. Some 20 years ago, it was obvious that interdisciplinarity as a mission had failed, but at the very same time it became apparent that the traditional pillars of academic wisdom were cracked and that previously well defined disciplinary domains were merging, to the horror of many. Only one element was hampering the demolition of the dusty temple: the lack of a common methodology, a collective vocabulary, a general theory that could function as a fertile ground for the postulation of even wilder things to come. And suddenly the words were all over the place: chaos & order, complexity, artificial life, cellular automata, self-organization, virtuality, smart materials, fuzzy logic, dynamical patterns, adaptive systems, ... The palace revolution had started and the punks took over the security guards. Some older guys who previously had been pushed into the peripheries, headed the gang. Paul Davies, Richard Dawkins, Daniel Dennett, Brian Goodwin, Stephen Jay Gould, Daniel Hillis, Douglas Hofstadter, Stuart Kauffman, Christopher Langton, Marvin Minsky, Dan Norman, Roger Penrose, ... are now considered the intellectual barometers of this time, and get the status of pop stars with equal broadcasting time.

From the beginning on, that new frame of analysis and research was not restricted to the hard sciences like genetics, physics, biology, or to deviant groups within artificial intelligence and logics. No, there was a strong belief that whatever was to be discovered or disputed could be of interest to any denomination within the social and human sciences, and arts as well. In an introduction to Ilya Prigogine's 'Order out of Chaos' Alvin Toffler suggested this as early as 1984.

Ever since, most areas have been tuning in: recent publications from sociology, philosophy, anthropology, and also communication theory use perspectives drawn from this 'scientific revolution'. Though the unresolved question remains: how can we look and at what exactly, and how can we represent all this? But there is a new authoritative certainty - whether right or wrong is not at stake here - that former views just yield a less complete picture of the world. Furthermore, the idea is out that we have to live with a lot of contradictive, heterogeneous theories applied with less certainty than what we have put to use in the past.

How Human are the Arts?

Now, turning to the human sciences - the field where for centuries content, cultural and social values, aesthetics and the interplay between them have been debated - we find a strong sense of isolation and stagnation. Not only has critique been paralyzed by an overrated historical consciousness, blind for the schism caused by the new scientific revolution's paradigms, there is also a strong luddite affiliation. This purely emotional aversion from automation of activities, as if it would obstruct the free thinking wet being called man, even founded a new subsection, knit together by anti-technological quotes from this and that renowned philosopher: technology assessment! Over the last 20 years the arts seem to have forgotten it has always been also a field for experimentation with media, content. and ideas. And finally, after missing the boat completely and over and over again, under strong instigation of the other sciences mentioned above, the arts are reformulating their position towards interdisciplinarity.

In this rescue operation, it obviously has lost its sovereignty within the academic world. This is not a trivial issue, at least not for the field of education. The cultural literacy debate may be considered one of the last outcries of a dying world. It is the desperate attempt of a couple of old white men to put traditional knowledge and methodological revisionism back in the saddle. The whole discussion was politically driven by conservative governments but backed up by either center and left. Of course it had nothing to do with politics, but with the way a changing world was imposing its demands on society itself.

How Literate are Martians?

Hirsch's statement conformed to the American tradition in which lists are the representation of the facts behind the curriculum: *Cultural Literacy. What Every American Needs To Know* (1991) claimed to be built on research and learning theories, and concluded with an extensive list of names, dates, items, words. It advocated a common knowledge as a solution for dropout and failure. Roger Schank, in his *Engines for Education* (1995), dismissed the position as inappropriate. He extensively showed Hirsch's fundamental misconceptions of current research, communication models, and learning theories. Back to the real world. About 20 years ago in school I had to learn by heart all the states of America and their capitals. Now there is a company who sends out a demo package for computers to do speech recognition. Your computer is a quiz-master and you have to reply the capital for the given state. To my embarrassment I did not know anymore what the capital of California was. So much for my 'schooled mind' of course. So much for the list-approach and common knowledge myth, I guess, because you cannot force a background and situation on someone, which leaves room for speculations about more essential questions. How do we organize a dynamic curriculum based on different and common styles of learning, dependent on the individuals involved, and how do we introduce temporal changes. Secondly how do we assess learning, and how do we feed the results - if any - back into the curriculum. Thirdly, how do we provide schools and individuals with the necessary equipment, tutors, and finances to safeguard a long-term organization of learning with different collaborative and individual units.

All these questions are addressed frequently nowadays, but somehow it seems that the cultural division between old and new still obstructs a common view, on how to act effectively in this society, knowing that there is only a soup out there, a loose collection of disparate knowledge. Reformulating this for instance from the point of view of art: How are you going to deal with culture and art in a world where literature, video, film & music, and other arts become indistinguishable from each other?

The traditional historical method is to a certain extent useless, since it leaves out the crossovers to save the disciplines. To my own astonishment, most people lack the necessary background in 20th century art to use it satisfactorily: when most of the constructivist academics have never heard of the Russian constructivist movement at the beginning of this century, when engineers robotics have never read (even about) Capek or Asimov, when multimedia designers has never seen any dadaist film experiment from the thirties ... My judgment is that they won't necessarily be bad theorists, scientists, teachers, artists. The only conclusion we can draw here is that the humanities have failed tremendously in conveying creative models for dealing with necessary activities nowadays: whether you talk about cognitive, cultural, or educational things.

Another answer was supposed to be found in the works of the current fashionable breed of French Postmodern philosophers like Jean Baudrillard, Gilles Deleuze, and Felix Guattari, Bruno Latour ... Nowadays fiction and technology seem to merge, in a sense that the everyday use of electronic money, digital sound and images, cybercommunications, etc. trashes most of the utopian science fiction predictions from let's say a decade ago. Philosophy, like we already mentioned above, hasn't been too inventive lately. Apart from the inefficiency of technology assessment to act as an 'ethical' filter and controller in the proliferation of the digital era, the critical distancing techniques formerly used to comment and reflect on socio-cultural change proved to be totally inadequate dealing with media technology. Baudrillard, Deleuze and Guattari and others can try to formulate insights and theoretical foundations, due to the quantification and commodification of the media. They try but they are not heard at all, and therefore are irrelevant in the media debate. One of the reasons for this could be that the languages within the media - natural and artificial - conflict radically. To give one trivial example *one size of course doesn't fit all.* In the philosophical essay "rhizome" our famous and over-quoted friends bullshit away for as long as 65 pages to describe what is generally referred to as a network, and the metaphors it could allude to. In fact when they describe a rhizome it takes them approx. 15 pages of incomprehensible and abstract jabber to explain nothing else than what Ted Nelson and others were talking about, in much clearer and more influential language, some 20 years before.

Now Deleuze and Guattari do the story over with metaphors, mystifications, and doubtful analogies. But that is not the major problem. By doing so, they don't add anything to the picture we already have, constructed by our individual use of cultural and technological artifacts. So, this form of abstraction leads not to a better understanding of innovations in society, a cognitive change, or a cultural dynamic. On the contrary, it is in essence a centralist move

- rather in the spirit of the former literacy debate - to save the boundaries of the discipline by declaring it open and well-suited for creative use.

Not only is the language itself unsatisfactory (incomprehensible as we labeled it, but call me an idiot if you understand it and you explain it better to me), also the form in which the language occurs is totally ineffective to acknowledge the position it claims: debate is out there on the network itself and not in the printed medium. Furthermore, the definition of the networks and the cultural artifacts related to it are dynamically created on the network and by the users (including industry), but not in the mind of some chic philosophers, or in a series of publications after the fact.

And so the last text by Felix Guattari before he died, *Remaking social practices*, got merciless slashed to pieces on the nettime-list recently. So much for the inadequacy to mix, and trash, and clash. (I know, endurance exists only in the printed world.). Latour already warned against what he called the 'disillusioned rationalists'. Maybe the sterilizing effect this kind of discourse has on our culture in general, can also be comprehended looking at the art world. Characteristic is the choice of the curator of the last Documenta, Catherine David, to expose existing works: there is no new productive message to be launched, no creative task to set out but expose what already has been done. There wasn't any Documenta before so drenched in discourse: more lectures than artworks were presented to the audience. The catalogs mentioned good old Roland Barthes, Jacques Lacan, Louis Althusser, Michel Foucault and Jürgen Habermas as if they were still alive.

And I guess we expect more in these neo-postmodern years. There is more happening than just global economy and a monolith capitalist system. The commodification of research and development throughout the dependency on machines and software (from text processors through organizers and mail programs) is also chaperoned by a whole set of new conducts and practices. So it is not enough to say: "look people, the picture is fuzzy" or shout out "chaos-theory", whether we talk about media, culture or education. It is not enough to shout "simulation" to reality, and indulge into an ultimate reformulation, ironization and redoubling of theories and practices. And finally it is not enough to denounce 'Mickey Mouse' culture and hide into cultural and political protectionism.

We have to take seriously into account the present activity-shift, the job-hopping happening at the other end of the fashionable debates, in order to realize the potential behind the new tools we use, even if they will prove to be the emperor's clothes later on. There is an obvious split occurring, one that no-one wants to stop, because the promise at the other side of the hill is much more rewarding, maybe out of selfish curiosity or crazy trendyness, but much more because there is bread in it in the first place.

From Data to Wisdom, Will the Real Hologram Stand Up?

Now the discussion we have been conducting so far may seem far-fetched or only for a crowd of insiders. But it serves as an illustration of how our disciplines fight to persist, despite a radically different and alternative construction that encircles them, threatening certain authorities, and constructing new ones. In a way it predicts the end of traditional epistemology and philosophical/critical discourse, and it embodies the slow germination of elements, which could - but not necessarily - breed a new genre of academic and socio-cultural practice, maybe an educational one.

We want to portray the difference between what we jokingly call (in true post-neo-startrek style, I know) "the battle analogs vs. digitals". It comments on the growing schism apparently occurring throughout the use of those specific media, called new media (to separate them from pre-80s technologies), and the reconstruction of a new kind of discourse springing from that digital fountainhead. Finally it illustrates the complexity of attitudes, or beliefs, towards information and knowledge.

At both ends of the continuum we can identify different sensibilities that position themselves paradoxically and antagonistically against each other. On one end there is a belief in abstraction as the representation of many phenomena occurring in reality. The belief is that generating new abstractions can lead to a better insight in reality. The other end does not recognize this as a plausible method, and only validates inferences derived from concrete data. This results in a new form of behaviorism, visible in the new developments in machine vision, software agents, ...

Another characteristic belief can be described with the terms involvement and participation. Whereas the traditional brand of academics still believes in 'distance' as a condition for formulating critique, others emerge who claim 'involvement' as essential. That this difference is not merely a generational or technological discrepancy is illustrated by Clifford Geertz's *After the Fact* in which he looks back on his career as an anthropologist, claiming that there is no general truth and a singular history, while reflecting on his personal fieldwork and relating it to some developments within human sciences.

This leads us to a third paradigmatic difference: 'situatedness'. It is the tip-top where anti-abstraction and involvement meet, and takes into account the environment in which the network is situated, with its almost tangible users/participants. It is the dynamic attitude of recognizing the inca¡ability of escaping the social construction which constitutes the artifacts that surround us. A well-known example is Donald Norman's *The Psychology of Everyday Things*, one of the publications that contributed to the change of cognitivism as well as the start of a new direction in interface design.

There are many different views possible, and worth mentioning, only to get rid of the false dualist representation in the former paragraphs. Manuell Castells talks about *transformists*, *continuists* and *structuralists*, to indicate the different attitudes and views in the information technology debate. Transformists believe in the major transformation of everyday life due to the exposure of new information and new ways of dealing with that information. Continuists see the information revolution rather as an evolution from previous stages of communication systems, and are skeptical about the value of that apparent change. Finally structuralists believe that information technologies don't change the nature of the industrial society, and don't believe in a new social order emerging from it. Of importance in the debate is the rate at which institutions like schools, banks and public spheres change, and to what extent.

This reminds us of the old Piagetian paradigm: assimilation-accumulation. Papert states that the traditional school system doesn't change through accumulation but assimilation. Schools only accept what secures the persistence of the existing situation. Therefore - according to Papert - the first waves of technology did not change the organization of learning and teaching and was driven to its own bankruptcy, since computers were only adopted as add-ons to emphasize existing methods and organizations. OK, that was back in the 80s but do we have reasons to believe that the situation is different now? Can the new computers and network technologies reinforce the necessary innovations to educational systems?

From Wisdom to Creativity, Can I Have Another Piece of Teacher?

We believe that during the last decade the world has changed profoundly due to the proliferation of hybrid networks of computers and human beings, in an admixture not existing before (think where Castells would classify us!). Discourse in general has changed because the participants and the subjects have changed. Though there remains much more work to be made of real research into the use of multimedia and network media, instead of the bulk of justifications we often rely on. It is clear that current technologies are able to change the nature of information (the format) together with the cultural settings in which it is handled (the context and use).

The multitude of communication means allow us to think, express ourselves, and gather information in quite different ways than before: e-mail, listservs, news groups, chatting, video conferencing, the different www-implementations via javascript, java and cgi's...

In a couple of years' time the idea of the Net, the Web or any other cozy name you give to it, has changed because of the activities that are deployed on it. Kids do it, elderly people do it, professionals and unemployed do it, morons get spammed. Obviously, design is perceived through the innumerable graphics, movies, and animations that form an indispensable part of the experience of getting through data, downloading programs, and submitting a request for more information. But the real value of the 'design' is present in the simplicity of the format of the html-page, and the triviality of uploading that to a remote server. Anyone can do it; free tutorials and tools are abundant on the medium itself; and what is more, they are widely used!

To be honest, most people, including teachers and students of any age or gender, learn it quickly without taking traditional classes. They don't cling to the idea that you need a certificate to work with it, contrary to most other technological activities like driving cars or installing air conditioning. To our own astonishment two2 years ago, we could guide a bunch of language teachers through online resources and then stimulate them to make their own homepages, in only three evening sessions! They had never had any previous experience on the web but in the end some even had frames and animated gifs in their pages. Whether afterwards they could put it into further use or not, is beside the point here of course. Well, it takes more effort to become a good instructional designer, but on the other hand, we could argue that with such a transparent medium, some simple tools, and good common sense one could get far. And has not the teacher with or without technology always been some sort of designer without proper training, rather developing his/her experience in the field? So if we would be able to give a necessary introduction in technology, and get the message of innovation and change across ... but, many have said this before and I guess that would be too easy for teacher trainers...

Within the school environment, the difficult factor has always been access to equipment, for teachers and students alike. But recently, most of our governments and school managers have made a great effort in getting computers there, a tendency that is unlikely to stop (long live commodification?). What we grew more concerned with at the same time, however, was the ineffective use of information technology in the classroom and the fact that it proved difficult to integrate within traditional curriculum settings. Of course we are convinced that integration is very important, if only to comply with Seymour Papert's notions of successful implementation. But shouldn't we broaden our view in the light of what authentic activities on the net consist of, and allow the participants to change the classroom? There are various reasons why constructivism, open and distance education are badly understood and implemented in the field. In fact the whole of educational innovation with ICT has by many been perceived as a threat, where it should have been acquired as a benefit and convenience. But that is the exact point where we started this paper.

It seems hard to achieve innovation, because it requires more than good courses in new technologies, because what we really want is attitudes and proficiencies, even buildings and institutions, to change. That can only be brought about when the participants are immersed in authentic practices in which change seems evident, unconstrained, and intelligible. One way could be to enlarge our view of integration to the broader diversions in which students participate. Let us forget classroom borders, and design information, activities, and resources for a cultural setting in which school is no longer a singularity. Obviously we have to include the technological activities at home, at work, whatever they are, and relate them to the construction of expressions and models of knowledge that constitute learning. Now we see a lot of learning happening already out there on the web that is not always recognized by teachers, because they find it hard to assess. I think of the participation in list discussions and news groups, browsing, searching, saving local files for later use, playing games, making html-pages, animations, and the like.

I have seen more peer learning, coaching, and facilitating on the net only during the last year, than ever before in any classroom. Also, the subjects were not exclusively related to the medium itself, but included references to publications and resources outside the web. Thus, we cannot but take new ways of communicating seriously, because they modify our way of perceiving the world and alter our ways of thinking/learning. David Jay Bolter, in *Wired 5.01*, talks about the infamous Myst and Doom games as subverting the values of print because they supersede the book and, along with it, traditional verbal identity. The only ones who experience it as a threat are those whose values were formed in and by the age of print. He ends asserting that if the Supreme Court Justices would recognize this, they wouldn't worry about banning pornography, but they would ban "inexpensive digital cameras, graphic accelerator boards, 3-D rendering software, and, above all, the freedom to merge your point of view with that of a raindrop." And doesn't that last statement come very close to what we expect the learner to do?

Panic Design and Positive Breakdown

The educational digital designer from a constructivist point of view has to deal with the construction of knowledge and at the same time the construction of models to deal with that knowledge, as Jonassen pointed out long ago. But after a deep breath, and before he has jotted down his first tag, s/he already runs into huge problems. Due to the nature of the web, its users, and its applications, the participation of learner and teacher in a collaborative and culturally suited situation, is not a big issue. But what should be made of non-linear sequencing, the different media constraints, the status of the teacher, and designer or the quality assessment. By now, the teacher and most of the students are driven to despair as well. The more we try to get them involved in this uncertain learning/teaching situation with the use of ICT, the more we seem to push everyone and everything over the edge. So, maybe we have to turn to areas where the global wave of innovation and virtualisation progressed better, and learn from experiments that have succeeded. Even if they require a more radical point of view, we have to try to adopt them, instead of concentrating on the remediation of the growing mismatch of social and educational implementations.

Karamjit Gill, in the first chapter of his *Human Machine Symbiosis, The Foundations of Human-centered System Design*, extensively comments on methodological issues and combines dialogue, action research, and other collaborative techniques. Reminiscent of Terry Winograd and Paul Adler's *Usability, Turning Technologies into Tools*, traditional design is challenged. Drawing from the work of Polanyi *The tacit dimension*, the concept of "tacit knowledge" is elaborated in recent research. Also, some fundamental concepts for human-centered design like usability, breakdown, tool perspective, and language approaches are introduced. Especially the concept of breakdown is seen as a fundamental aspect of dialogue, reflection in practice, and mediation - all central concepts for educational design.

"While it is desirable to situate tools and systems within existing traditions and practice, breakdowns are also essential elements of innovation, creativity and designing for the future. This is the essence of participatory and cooperative design within the tradition of human-centeredness" (p 28)

Finally the concept of "user-involved" design, a set of cooperative and participation techniques, seems adequate to cope with current field problems in education, from the organizational, technological, and socio-cultural point of view. It can bridge a gap in a rather traditional and static environment, and realize part of the (social) constructivist agenda on a very immediate level, by involving the user directly in the development of interactive content (for learning). The designer is adopting a new role, but not by imposing solutions out of the blue - faintly hoping it will benefit users' skills. Designer becomes Mediator, using new strategies more appropriate to sustain the dynamic process of learning, in which novice gradually transforms into creative expert through dialogue with content and tools.

That sounds encouraging, doesn't it? But now back to the bench where the computer is waiting.

Open That Can of Software, Waiter

We try to implement these ideas in several cultural and educational projects, using different media and targeting different kinds of users. In each case we hope that the initial concepts, formulated as a task for us, can evolve

into the creation of a collaborative product, and can help the people involved to take on similar projects in the future. In 1991 we started with the development of a collection of contemporary references to several classical European literary works. We wanted to trace the corrections to the traditional canon, and reconstruct a debate through several representations in media and arts. The first outcome was an electronic book on disk on Cervantes' *Don Quixote*. The material was used for presentation of the research project and documentation on the subject. The second collection, on Defoe's *Robinson Crusoe* was done in 1992 and was transferred to www in 1993. The idea we had at that time, reflected a naive belief that very soon others would add to the collection and even, eventually take it over, to the benefit of education and culture. We contacted teachers from different disciplines to collaborate. Some came, some even proposed ideas, but most of them nodded and looked away. Most of them did not have the time, equipment, or desire to collaborate with an experiment. They also were very diffident about networks and after a while we moved to another project.

We were asked to document a governmental initiative about curriculum development and attainment goals for art education in Flanders. The idea was to "hyper-edit" the document with multimedia examples from classroom practice. The first change we proposed was the idea to mount it on a server instead of producing a CD-ROM. Secondly, we asked some organizations involved in art and children to try to document their projects for further linking. We hoped they would learn how to 'publish' on the web and maintain this service later on by themselves. Finally we went out to document good and useful practice in schools and other teacher education institutions. The idea with the external organizations did not really catch on though they were enthusiastic about it at first. We succeeded though in documenting some interesting projects ourselves and relating that to the cross-curricular spirit of the original text. We still think it is a nice environment, but additional funding would be needed to change it completely into a more collaborative environment supported by a larger school-based number of people. We still think the initiative came too early. There was not really an awareness of the possibilities of networks in our Flemish schools.

Then we got caught up in a series of projects resulting in a large conference for the whole of education in Flanders. While organizing the conference we developed a CD-ROM, documenting the involvement of teachers (primary and secondary education) into classroom practice with ICT. It became a timely document on disk showing attitudes and realizations about ICT, still without governmental involvement. It was interactively presented at the conference.

Currently three important projects are being carried out. The first project documents the development of a CD-ROM about multicultural childcare. It was conducted by the department of Psychology at the University of Ghent in collaboration with several partners from France, England, and Ireland. Each partner finally submitted a scenario for an interactive part, including all material (photos and video, graphics, sound) and a description of interactives. The CD-ROM was introduced at a conference in October 1997, and made a tour through Flanders on a so-called "technology bus". Recently the project team decided to switch to a non-involved method.

The second project describes our participation in the development of a "virtual center" on the web, for a European project called T3 (Telematics for Teacher Training). Our involvement started late in the project, and had to cope immediately with a very confused and complex situation. Due to circumstances, the so-called 'T3-centrum' was virtually non-existent, and separate www-environments had been developed by several partners. The first task was to coordinate a group of art students who were proposing a concept for the virtual centre in December 1997. Depending on that, a strategy for implementation, development and collaboration among the partners was introduced.

The third project is the creation of a www-course on cultural literacy at University of Ghent. The basic material has been selected, but since we believe that only through participation the environment can become binding, we are looking into a number of ways of involving students. The task is to go beyond the constraints of the traditional setting in which academic learning takes place, due to limitations of infrastructure, access, attitude, and assessment. We have already named the project secretly 'the conflict zone', and we hope it mixes down well with the imploding territories and blurring borders as they are explored and documented.

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INTERNATIONAL

Section Editor
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As information technology draws us all closer together I am sometimes surprised that every section of this annual is not entitled "International this" or "International that." This year a much greater number of papers that several years ago would have been labeled "International" have been placed in other sections. Too, the majority of the papers in this section could have been categorized under different headings. During the sorting process I looked covetously at those from distant parts of the world that have become the provenance of other section editors.

Each year as the papers come in to me, with exotic stamps and far-flung return addresses, I am once again a young girl on a dusty Texas farm, dreaming with the world atlas in my lap, traveling the world, but now with the added threads to other teacher educators, and through them, to the children of the world. For all these vicarious trips I thank the authors is this section.

While we are all drawing closer together I ever delight in the differences that languages and cultures impart to this whole teacher education and information technology communication process. As editor of this section I feel a heavy responsibility to present each of the papers in a manner true to the intent of the author or authors. At times that means that I must sometimes take words that have been translated into the authors' second or third language and make them sound like standard English without loosing the essence of their thoughts, their works, their philosophies. It is a heavy responsibility, but it is also a joy.

Part of the joy each year is planning a trip to visit each of the authors. This provides a convenient way organize this section, a 'braid' of coherence; strand one is teacher education; strand two is information technology (IT); and strand three is proximity, if South America can be considered a near neighbor to Australia. I also think it important to start from a different continent each year so I begin our journey in South America. [See Figure 1 for the starred focus locations.]

The first paper is a collaborative effort by Martinez, Astiz, Medina, Montero, and Pedrosa, of the National University of Mar del Plata, Argentina, who report on teachers' positive opinions of IT integration but lack of its actual use in their classrooms. Crossing the south Pacific to the University of Sidney, Caitlin Cronin and David Reid address a similar problem with suggestions for overcoming the *status quo* through focusing on pedagogy rather than technology. Sail north to Malaysia where Ab. Rahim Bakar and Shamsiah Mohamed explore perceived IT roles of vocational and technology teachers.

Continuing north Greg Lee and Cheng-Chih Wu at National Taiwan Normal University share their design and implementation of a computer education course that combines computer literacy with practical pedagogical issues. Leaving Asia, across the Indian Ocean to Africa, find several papers deal with IT and teacher education in a very different culture. Paul West, Technikon Southern Africa, addresses a number of difficulties related to IT integration in Africa and puts forward a suggestions for solutions. Next, Marí Peté, Technikon Natal, provides follow-up research on the "KwaZulu Concept Burger" [see SITE97] with some interesting data on the continued use (or lack thereof) of materials produced in differing media. Peté with Parivash Khalili then consider the implications of the post-apartheid national educational policies and the changing roles of lecturers that will result.

The next paper comes from the east African coast via several professors from Texas Southern University, Claudette Ligons and Wren Bump, who describe a Fulbright Project that took them and others to Tanzania for a five-week immersion in the culture. This experience was later integrated into their teacher education program through a Web and other media.

Leaving Africa the road leads north to Kiev. Yuri Demchenko describes the experiences of the past two years as the Ukraine struggles to implement cooperative and contributive learning models and IT in the midst of economic restructuring that would daunt most of us. Turning to the west the reader will see that there are many universals in IT integration in teacher education. We cannot consider this process without looking at what our various governments are doing, pro and con. Along this line, Baron and Bruillard

provide an eloquent view of France's new national plan and its implications for teacher education.

Across the English Channel to London Hughes and Sasse describe a project that involved teachers in the design of their own instructional media with the ultimate goal of putting them more in charge of IT. Northwest of London at Keele University, Staffordshire, Dunning describes an IT and motivation study of direct practical significance to teacher educators. Westward across the Irish Sea are two such educators, FitzGibbon and Oldham, of Trinity College Dublin, who report on their preservice teachers readiness to integrate IT and they offer a case study of a system in transition.

Turning back east to the Open University of the Netherlands, Kirschner, Hermans, van den Boom, and Münstermann are doing similar work on inservice teachers. They look at ways teachers may be retrained for educational innovation and IT. Clayton Keller, University of Minnesota, Duluth, and Ragnar Thygensen, Norwegian University of Science and Technology, move back and forth across the Atlantic through videoconferencing. Their paper shares the technical, logistical, and educational issues they faced over two academic years as they connected faculty and students at their two universities for lectures and discussions.

Moving west from Norway to Canada, Christina Dehler of Concordia University also investigates the benefits of using IT to move across international boundaries to expand our cross-cultural understanding. Heading south the final paper in this section provides an excellent example of what Dehler has suggested. Deborah Pulliam describes how one college, Missouri Southern State, infused their entire curricula with a campus-wide China theme that involved extensive use of IT.

While this vicarious trip has brought me back to the central USA (Missouri is just south of Iowa), the final paper has shown how IT can provide multiple windows on the world. All the papers give me a feeling shared humanity and purpose among the IT teacher educators around the world. We face so many of the same challenges, some we have met and conquered; some we have yet to meet; and some we are still struggling with. Just knowing that others are dealing with similar conditions is strengthening. Also, too, is this *Annual* as a resource for locating others who may have answers to our questions.

Figure 1. Locations of IT focus.

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Attitudes and Habits of Teachers Towards Computers in Education

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This paper reports work on the process of incorporation of the computer as a pedagogic tool for school activity, in the Basic General Education (BGE), at the County of General Pueyrredon, Province of Buenos Aires, and its area of influence. Argentine schooling, that is undergoing a process of reformations, currently presents general characteristics of encyclopedic and memorization type learning, with low development of critical thought and little contribution of technology to the classroom work. These conditions are reflected in the habits of current teachers and are implicitly recognized in official documents, These documents emphasize the need for training teachers so they can assimilate the innovations taking place in educational policies as well as in the pedagogic field of their respective specialties. The Continuous Educational Formative Federal Network is an articulated system that includes objectives for the planing for training of inservice teachers. In a previous research work (Martinez, Astiz, Medina, Montero, & Pedrosa, 1997), we explored the feasibility of implementing computer supported learning environments. This was done by means of analysis of school equipment with regard to hardware and software, the degree of usage of these materials, the attitudes of teachers towards the incorporation of computers into school activities, and the government attitude and policies. Even though the survey on attitudes of teachers had given positive results, it was necessary to deepen and extend the inquiries in order to determine how well teachers were able to utilize the computer as a tool of support for the active process of building knowledge and developing activities.

Training

Training, set up for the official group of teachers in service from the BGE, included both distance education components and presential components, i.e., components delivered locally. In the distance education stage each teacher received a set of modules on diverse general aspects and of contents of the educational reformation in the Province of Buenos Aires, following the outlines defined in the Federal Law of Education (GDCE, 1995).

The stage of presential training, on the pedagogic utilization of the computer, was developed within the framework of the Continuous Educational Formative Federal Network and by agreements between the National University of Mar del Plata and the Direction of Culture and Education of the Province of Buenos Aires. It consisted of a three-module course, twenty hours each, using Microsoft Works for practical and operative purposes. Once the teachers had their three modules approved, they then had to present a proposal related to the pedagogic usage of computers in their schools, using the studied technological resource. They were given several weeks for the elaboration of this and the proposal had to be evaluated and approved in order to successfully complete the course.

For the purposes of this research, it is interesting to note some critical objectives of the educational reformation and its appearance in the corresponding sections of diverse branches of thought. As a matter of fact, each one of them appears in a chapter dedicated to describing a set of attitudinal contents leading to the building of a critical thought (FCCE, 1995; GDCE, 1995). Of this set, we consider as outstanding the following:

- Confidence in their abilities to pose and solve problems.
- Pleasure in generating personal strategies for solving problems.

- Interest in the utilization of a logical, creative, and strategic reasoning.
- Critical and reflexive position facing the results obtained.

Therefore, it was to be expected that the classroom proposals developed by the teachers would reflect, although imperfectly, those attitudinal contents.

Hypothesis

The following are two crucial factors for the implantation of computer-supported teaching and learning environments that encourage the development of a critical thought:

- the attitudes of teachers towards the incorporation of computers to their classroom activities.
- the possibilities of overcoming their old working habits in order to assume a different role, as a facilitator of the teaching and learning process within a creative atmosphere, sustained by the computer.

Objectives

- To determine the attitudes of teachers toward the computer with regard to the following dimensions: anxiety, confidence, and liking.
- To learn teachers opinions about the different modalities on the usage of the computer in teaching activities.
- To determine the degree of modification of their habits required in relation to the making didactic activities to adapt themselves to the new educational needs.
- To associate the three preceding points.

Method

Subjects

Ninety-two inservice teachers were selected at random from official schools at the end of the training courses about the pedagogic utilization of the computer. Of that set, there were 50 rural teachers and 42 urban teachers. The population from which the sample was taken was composed of teachers belonging to the BGE who had no previous experience whatsoever in the usage of computers for instructional purposes and who were required to complete the course at this stage of training.

Instruments

a) In order to determine the attitudes of teachers, a five points Likert scale (1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree, 5 = strongly agree) survey was used. Just for this, an adaptation of the "Computer Attitude Scale" (Gressard & Loyd, 1986) was made, which consists of 30 items that measure the following dimensions: anxiety, confidence, and liking.

b) To determine the appraisal opinion of teachers about the different forms of educational usage of the computer and implications, a 20-question survey was made, with a five points Likert scale. The opinion items referred to the teaching activities to be developed using the computer in different ways. The activities over which teachers had to give their views could be divided into four big groups, namely:

- activities with the computer's controlled tutelage;
- usual activities with the computer as a tool;
- activities in which the computer is employed profitably to exercise the critical thought and the solving of problems, and
- the social implication of computers on education.

Note: In both surveys half of the items were framed in an affirmative way and the other half in a negative way; then, a random presentation order was established. All answers were codified so that the highest mark corresponds to a more positive attitude with respect to the usage of computers (attitude survey) or to a greater coincidence with the item, had it been worded affirmatively (opinion survey).

c) To determine up to what point teachers adapted their didactic proposals to some critical aspects of the new contents within the reformation, and that were mentioned in section "Training", a protocol for the analysis of those proposals was designed. The analysis protocol discriminates whether the works teachers present for the integration of the computer in some educational activity, take into account or not the following activities:

- searching for information,
- gathering of information,
- organization of information,
- representation of information,
- storage of information,
- writing of reports, utilization of text processors,
- usage of data base administrators,
- usage of spreadsheets, text comprehension,
- interpretation of graphics, setting up relations,
- making comparisons, and
- doing inferences.

Techniques of Analysis

a) Alpha coefficients were calculated to measure the reliability of both surveys using BMDP software (Dixon, 1992).

b) The same software was used to investigate the dimensionality of the survey over the scale of attitudes. These studies were carried out by means of a principal components analysis, followed by a varimax rotation and a maximum likelihood factor analysis.

c) Attitudes of rural teachers were compared to those of urban teachers, in the three main dimensions considered, using a BMDP software. A comparison of similar characteristics was performed with the opinion survey on ways of usage and implications.

d) The didactic proposals presented by teachers were analyzed by means of the aforementioned protocol and, as indicated, it details the activities to be done by the pupils in the presented proposals.

Results

Reliability

- For the Survey of Attitudes, a general reliability coefficient of 0.91 was obtained; for each sub - scale the results were: Anxiety: 0.94; Confidence: 0.90 and Liking: 0.90.
- For the Survey of Opinions on the educational uses of the computer and implications, a reliability coefficient of 0.62 was obtained.

Factor Analysis

The analysis of the dimensionality of the scale of the Survey of Attitudes was performed over a data correlation matrix of the 30 items of the instrument. From the analysis, five factors arose that were coincident for the principal components analysis as well as for the varimax rotation factor analysis and the maximum likelihood factor analysis. Considering these factors, the first three can be reasonably identified as anxiety, confidence and liking, while the other two, with much less relative loadings, such as self - esteem and interest for complex actions.

Attitudes of Teachers

From the computation of the attitude survey, completed by each one of the teachers, the values below mentioned were obtained. The following table shows the mean and standard deviation of the data obtained in each one of the three main dimensions, differentiated in rural and urban teachers.

Table 1.
Attitudes of Teachers

Dimension	Rural Mean	Rural St.Dev.	Urban Mean	Urban St. Dev.
Anxiety	4.09	0.18	4.17	0.21
Confidence	3.31	0.50	3.67	0.41
Liking	3.68	0.27	3.93	0.18

Differences between Rural and Urban

A comparative analysis between the mean of urban teachers (U) and the mean of rural teachers (R) in each sub-scale was carried out, with the aim of determining whether significant differences in favor of the first ones existed or not. Because of that, for each of the dimensions under treatment the following null hypothesis and alternative hypothesis were proposed:

$H_0 = U - R \leq 0$ and $H_1 = U - R > 0$

Let us consider each case

- **Anxiety.** The estimation of the statistics for the t - Student distribution yields a value of 0.48; it follows, the null hypothesis must be accepted and, therefore, there are no significant differences in favor of urban teachers, even considering a level of significance as high as 0.25.
- **Confidence.** The estimated statistics value is $t = 1.85$. If we fix a 0.05 level of significance, we conclude that the null hypothesis must be rejected and, consequently, it should be accepted that at the indicated level of significance the mean for urban teachers exceeds that for rural teachers.
- **Liking.** The estimated statistics value is $t = 2.42$. At a 0.025 fixed level of significance, it can be deduced that the null hypothesis must be rejected and, consequently, it must be accepted that, in this dimension at the indicated level of significance, the mean for urban teachers exceeds that for rural teachers.

Opinions of Teachers

From the computation of the opinion survey, the below mentioned results were obtained. Just for this, we have constructed a four row table, each corresponding to the four thematic groups in which questions had been divided. The four groups and their identification are the following: Group A) activities with the computer's controlled tutelage; Group B) usual activities with the computer as a tool; Group C) activities in which the computer is employed profitably to exercise the critical thought and the solving of problems; and Group D) social implications of computers in education. The following table shows the mean and standard deviations of the obtained data in each of the four groups, differentiated whether they belong to urban or rural teachers:

Table 2.
Opinions of Teachers

Group	Rural Mean	Rural St.Dev.	Urban Mean	Urban St.Dev.
A	2.03	0.28	1.97	0.24
B	3.28	0.43	3.41	0.51
C	4.21	0.19	4.13	0.22
D	3.28	0.42	3.19	0.38

The comparative statistical analysis between the mean of urban teachers (U) and the mean of rural teachers (R) found no differences in any of the four groups, considering reasonable levels of significance.

Analysis of Didactic Proposals

Of a total of 92 works presented on the utilization of the computer in the educational setting, 25 referred to administrative activities of the teaching task, such as keeping records of the students' marks, holding a data base

with general information about pupils, etc.; since these are not classroom activities, those works were excluded from the analysis. The remaining works amounted to a total of 67, of which 35 belonged to rural teachers and 32 to urban teachers.

Areas of Knowledge

The works comprised the following areas: Language (L), Mathematics (M), Natural Sciences (NS), Societies and Geographical Spaces (SGS), Human Activities and Social Organization (HASO), Technology (T) and Physical Education (PE). The amount of works affected to each area, together with its rural or urban discrimination, are shown in the following table.

Table 3.
Areas of Knowledge.

	L	M	NS	SGS	HASO	T	PE	Total
Rural	3	4	2	16	8	1	1	35
Urban	4	5	4	7	8	2	2	32

Amount of Activity Types

Each proposed work implied the execution of a set of different types of activity, which were discriminated in the analysis protocol. The average activity types per work are indicated below.

Table 4.
Activity Types per Work.

Average	Activities Type per Work
General	7.15
Rural	6.74
Urban	7.59

The Most Frequent Activity Types

The five most required activity types, and the only ones that were incorporated to more than fifty percent of the works are the following.

Table 5.
Frequency of Activity Types

Activity	Percent of the Works
Usage of Spreadsheets	93%
Storage of Information	87%
Representation of Information	76%
Interpretation of Graphics	66%
Utilization of Text Processors	64%

Activities of Searching, Comprehension, and Organization

The activities of searching information, text comprehension and organization of the information affected the following work percentages.

Table 6.
Percent of Activities of Searching, Comprehension and Organization

Activity	Rural	Urban	General
Searching	34%	37.5%	36%
Comprehension	40%	59%	49%
Organization	43%	50%	46%

Activities of Setting up Relations, Making Comparisons, and Doing Inferences

These activities have the most importance for, in a sense, they are demonstrative of the type of deductions and reasoning implied in the works.

Table 7.
Percent of Activities of Setting Up Relations, Making Comparisons and Doing Inferences

Activity	Rural	Urban	General
Relations	2.9%	8.6%	6%
Comparisons	11.4%	15.6%	13%
Inferences	17.1%	25%	21%

Analysis of the Results

Attitudes of Teachers

Anxiety. According to the obtained mean values, 4.09 for the rural teachers and 4.17 for the urban ones, it is deduced that teachers have a favorable attitude towards computers and that anxiety represents no problem. The analysis of mean differences reveals that there are no significant differences between the two groups of teachers.

Confidence. Mean values of 3.31 for rural teachers and 3.67 for urban teachers reveal a moderate confidence about their interaction with the computer. The statistical study of mean differences indicates a greater confidence on behalf of urban teachers. This difference could perhaps be due to the fact that urban teachers have a general knowledge of computers somewhat greater and that this situation might influence their favorable attitudes (Rodriguez Feijoo & Stefani, 1990).

Liking. Mean values of 3.68 and 3.93 for rural and urban teachers, respectively, indicate a moderately favorable attitude in this dimension. The difference detected in the statistical study of the means could perhaps be attributed to the reasons mentioned above in the previous item.

Opinions of Teachers

Let us proceed now to analyzing the opinions of teachers in each of the four groups in which the total of the consulted items were divided. Beforehand, we must remember the groups: Group A) activities with the computer's controlled tutelage; Group B) usual activities with the computer as a tool; Group C) activities in which the computer is employed profitably to exercise the critical thought and the solving of problems; and Group D) social implications of computers on education.

Group A. The opinions with respect to the computer's controlled tutelage were unfavorable: 2.03 for rural teachers and 1.97 for urban teachers. These facts could be attributed to diverse factors, among which are worth to mention the articles written by constructivist educators, who severely criticize this type of activity, and to affective reasons, for this type of learning is commonly related to a "dehumanization of teaching".

Group B. The opinions on this group of activities were moderately favorable: 3.37 for rural teachers and 3.61 for urban teachers. These results could be attributed to the fact that teachers, in the instruction of the course, were able to observe some advantages that the computer could bring, as a utilitarian tool, to the classes they are teaching.

Group C. The opinions on this type of activities were openly favorable: 4.21 for rural teachers and 4.13 for urban teachers. This opinion, with respect to the computer as a cognitive tool, could be sustained on the considered view that at a scholarly level, and in the society as a whole, that computers are tools for activities of reasoning, reflection, development of strategies, solution of problems, etc., even though their use in this manner is not reflected in the daily practice.

Group D. The opinions over the social implications of the computer on education were moderately favorable: 3.28 for rural teachers and 3.19 for urban teachers. This moderate opinion is the balance of favorable opinions, e.g. that students could know and use this type of technology, that its dissemination contributes to improved productive efficiency, and of unfavorable opinions in which technology is seen as causing the reduction of job opportunities.

The Didactic Proposals

As indicated in the section on results, of a total of 92 works presented, 25 of them referred to administrative activities of teaching; from that, it follows, that 27% of the teachers presented no activity for the classroom labor, and therefore, they become excluded from this analysis. From the analysis of the 67 didactic proposals we can do the following observations:

Areas of Knowledge. Comparing the amount of proposals that rural and urban teachers produced, a homogeneity is observed between both groups, with the exception made with respect to the theme "Societies and Geographic Spaces", that had a marked preference among rural teachers, which is attributed to the environment where they carry out their activities.

Over a general total of 67 works, there are 39 that belong to the Social Sciences area (Societies and Geographic Spaces and Human Activities and Social Organization), meaning 58.2% of the general total of the works presented. This demonstrates a marked asymmetry in the utilization of the computer and points out the necessity of helping teachers in the development of didactic proposals in areas less considered.

Type of Activities. The amount of variety of activities presented in the proposals is reasonable, with a general average near seven different activities per work.

When the most frequent type of activities are analyzed, it is observed that they are generally of a routine type, except for the activities "Representation of Information," i. e., whether information is to be represented in a graphical way or in a written manner, and in which format. Also, "Interpretation of Graphics," consists of the interpretation of simple graphics (bar diagrams, graphical representations of linear functions, etc.).

Activities of Searching, Comprehension, and Organization. These activities require the students searching for sources of information, selecting and studying with comprehension the information, and, afterwards, organizing the information according to objectives they must reach. The general averages for "Searching" (36%), "Comprehension" (49%) and "Organization" (46%) are not bad, above all if one remembers that not all tasks require developing these types of activities. However, it deserves to be pointed out that rural teachers have lower averages than urban teachers do. This probably arises from the diverse limitations that the rural environment offers them.

Activities of Setting up Relations, Making Comparisons, and Doing Inferences. The percentages obtained for these activities are the most worrying of all, keeping in mind that they are indicative of the deductions and reasoning implied in the works. In effect, the activity of "Setting Up Relations" appears only in 6% of the proposals (2.9% in rural teachers and 8.5% in urban teachers), the activity of "Making Comparisons" is being practiced in only 13% of the works (with values of 11.4% for rural teachers and of 15.6% for urban teachers), and last, the activity of "Doing Inferences" is included only in 21% of the proposals (17.1% for the rural ambit and 25% for the urban one). It is necessary to point out that those activities referred to the establishing of relationships, making comparisons, and doing simple inferences.

Conclusions

The main conclusions of this research indicate that teachers have a good attitude towards the incorporation of computers into schools and that they consider positively

creative and the independent thought stimulating activities. However, by analysis of their didactic proposals, it is possible to observe an ample gap between what they claim to prefer and their presentations for classroom work. This seems to be the result of habits deeply - rooted, that are not easy to remove. An additional cause might be lack of renovation of knowledge, methodology, and content that would allow them to perform a different role, thus developing the type of activities they report to value. To synthesize, a set of encouraging expressions is observed, but these expressions are not always transferred to the labor with students. From the above mentioned, some recommendations are inferred:

- to accompany the instruction on technology for insevice teachers with a methodological and content actualization in their areas of work;
- to provide teachers with a supportive structure and a permanent counsel to aid their continued progress once they have finished the training courses; and
- to facilitate the interaction of the inservice teachers with researchers in order to construct and evaluate innovative learning and teaching environments.

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"Computer Proficiency for Teachers": Moving a Government Report into Practice

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In June 1997 the Ministerial Advisory Council on the Quality of Teaching (henceforth MACQT) of New South Wales, Australia issued a report entitled "Computer Proficiency for Teachers" (henceforth CPT). The report addressed how teachers should use education technology to support instruction and learning. In order to make the most of the computer, teachers and schools will have to adjust their approach to classroom curriculum, assessment and management structures as they currently exist. The report drew its conclusions based on existing literature, school visits, and surveys of current practice in schools and universities. Previous documents have addressed the use of computers in schools from a curricular or administrative viewpoint, but this report attempted to address the process rather than the content of teacher practice.

The computer competencies considered fundamental were broadly defined in the report as: basic operations, information technology, evaluation of software, pedagogical issues, and values and ethics (Sections 2.1-2.5). *Basic operations* includes the ability to understand the primary components of a computer, how to use software packages such as word processing, databases, and spreadsheets, as well as using the computer for drill and practice, desktop publishing and obtaining information. Beginning teachers should also have *information technology* skills such as using email, the Internet, presentation software and interactive demonstration to display their ability to find, choose, synthesise and exhibit information. They should also be comfortable with various software packages including the ability to *evaluate and integrate software* in the classroom setting. *Pedagogical issues* to be learned include possessing the "flexibility" necessary to shift instruction to a student-centred format. And finally, and perhaps most challenging and interesting for those who educate teachers, the report suggests that beginning teachers must have an understanding of the *values and ethics* associated with technology. This includes issues of plagiarism, intellectual property, censorship and quality control, as well maintaining a level of respect for colleagues without technology skills.

Of the nine report recommendations, three directly impact preservice training. The report recommends that by 2000 universities provide outgoing students with the skills outlined above and "that the transfer of these skills into practice be part of the supervision of the practicum component" (7.3). The desired skills and their application in classroom practice would thus need to be overtly demonstrated and recorded prior to graduation. Preservice training is also addressed by the recommendation that students receive a form of transcript providing evidence of technological astuteness as suggested in "Desirable Attributes for Beginning Teachers " (7.8-7.9). Unfortunately, even if the students do gain the skills needed to demonstrate technological aptness in a particular classroom situation that does not mean they will be placed in a school possessing the technology they have mastered. Neither might they be asked to teach the subject area or grade levels that they have practiced upon.

Critiques of the CPT

Although this report mandates change by threatening current students' future employability, it does not provide best practice models to guide teacher educators. The report also overemphasises the technology of today rather than its potential by requiring specific skills such as using a CD-ROM instead of outlining a direction for the more important issues like pedagogical and curricular integration. Undue and unnecessary concern is directed towards what might be considered generic people skills rather than technology specific skills such as exuding a respectful attitude towards those teachers without technological training (2.5). There are also concerns that the visited schools representing current practice were an inadequate sample.

What is particularly challenging about this report is that it encourages teaching styles and modes of curricular integration. Past ministerial reports have addressed specific issues such as special education, aboriginal education, gender awareness or multiculturalism. By addressing a tool rather than a perspective the report imposes a challenge in that it seeks to change what schools do instead of trying to

add another layer or dimension to the existing structure. Although the report's goal is to change the way school instruction is delivered, one danger is that teachers may learn the skills but not the ability to apply them. However, a teacher who has some technical understanding may then have the capacity to challenge what competencies are necessary and what skills are peripheral to the central goals of instruction. This baseline understanding may enable the teacher to ask sensible questions and challenge the technology to contribute to education rather than be simply and superficially dazzled. It is the teacher who stands between the technology and the child and must be able to mediate this relationship for educational goals to be achieved.

Despite the above critiques, one important consideration is the notion that beginning teachers are just that — novices and not polished professionals. While it would be criminal to graduate them into schools without technical ability, they may need to learn integration as they perfect a variety of styles and methods of instruction. The report should perhaps have struck a balance between what beginning teacher's need and what incentives should be developed to enhance inservice training through postgraduate courses or general staff development.

Current Practice for Preservice Technology Training

The following sections examine how the Faculty of Education at the University of Sydney plans to adjust to the MACQT mandate. It may prove useful to outline the evolution of preservice education technology training at the Faculty of Education to understand current internal practice as well as external relations with the Department of Schools Education. The Faculty of Education merged with the Sydney Institute of Education (SIE) when the universities as part of the Dawkins reforms absorbed the Colleges of Advanced Education (CAE's) across Australia in the late 1980's. Since the SIE conducted a much greater volume of teacher training, we will discuss their programs prior to the merger. In the 1970's the bulk of education technology training concerned the use of audio-visual equipment including television, film, and graphics although as microcomputers arrived on the scene they were brought into the curriculum. The Educational Technology Centre (ETC) was staffed by five academics, three technicians, a photographer and an administrative officer to serve approximately 1500 students and 240 faculty. Although there were no government mandates to offer compulsory technology courses, SIE education students took one mandatory course and had several option courses available.

In the 1980's as personal computers became more prevalent and affordable in offices, schools, and homes; they gained more space in the ETC at the expense of the audio-visual components. Students were not allotted additional time to accommodate the new technology so it had to overlay existing technology courses. The mandatory program now emphasised basic Apple applications for word processing, databases, spreadsheets as well as gaining some software evaluation skills. There was also some programming instruction available but this was in the realm of the mathematics instruction. Staffing remained at the same level as it had in the 1970's.

It is crucial to understand that during this time that there was a quite different connection between the state-level Department of Schools Education (DSE) and the CAE's that handled the bulk of teacher training. There were very close connections between those who trained and those who hired teachers. Almost all CAE lecturers had taught at DSE schools as well. Courses at the CAE were externally evaluated and assessed by the DSE. Additionally staff and students received income from the DSE. Thus the CAE's had little difficulty responding to the needs of the DSE as they adjusted their expectations of what skills a beginning teacher should possess. The tight coupling between these two components of teachers' careers allowed teacher training institutes to react to changing needs in a cooperative manner. The close linkage and cross-fertilisation between the sectors allowed for greater personal and substantive professional contact. Overt and underlying assessment was possible without formal intervention or mandates. Because of the size and scope of the SIE changes to the curriculum could be made quite quickly whereas now within a university structure changes or the formation of new courses can take up to two years to accommodate.

Currently teacher training is located in university structures that rely on far greater levels of internal assessment, management and governance. Students only encounter the DSE towards the end of their teacher training since they receive financial support from the Commonwealth government and staff rarely move back and forth between sectors. The DSE cannot influence staff and student preference through day to day financial incentives but they can induce skills output through connecting hiring and promotion structures to their curricular and pedagogical preferences. When change is mandated from outside the structure such as when the DSE alters their expectations of beginning teachers, staff who train teachers are now liable to two systems. They must work within their university structure that may hold different or contradictory expectations to the organisation whose mandate must be respected as well. Thus the CPT report was released in a more decisive and less personal manner than would have occurred in the 1970 or 1980's. Meanwhile the teacher education institutions now have less flexibility to respond to its demands.

Alongside the merger between the SIE and the existing Faculty of Education, the climate in the 1990's also saw increasing pressure from parents, the media and the DSE to

increase the use of computer technology in the classroom. The ETC shifted the focus of its required courses almost entirely away from audio-visual skills to the computer skills that had been introduced in the 1980's as well as the use of on-line resources such as email, the World Wide Web and bibliographic resources. Staffing levels now stand at four academics, three technicians, and one attendant to serve approximately 1250 students and 120 faculty. All students must enroll in a 12-hour introductory course that covers word processing, databases, spreadsheets, graphics and on-line resources such as the Web or ERIC. Students who undertake the B. Ed undergraduate course must also take a mandatory second year course that covers small scale television production, basic web page design, and rudimentary AV presentation skills as well as revisiting the skills emphasised in the first year course. They have the option of taking a course during their third year that exposes them to presentation software, more web design and some design tools such as Authorware. The students in the MTeach two-year postgraduate program may choose from four options after the initial twelve hour course that include computers and communication, desktop publishing, video production for classroom use.

The mandatory and optional courses address generic skills that are intentionally content-free. Students may also gain exposure to educational technology in their subject methodology courses such as project-oriented work in Technical and Applied Studies or software evaluation in Maths and Sciences. Students will only randomly be exposed to technology integrated into their subject content courses areas throughout the university. This is especially true in the humanities although the use of on-line resources for academic communication, teaching, research and collaboration and the growing provision of presentation facilities is altering traditional practice.

Adherence to the CPT by the Faculty of Education

Table 1.
Competencies Required of Beginning Teachers v. Current Course Offerings

	BEd Mandatory and Optional Courses	MTeach Mandatory and Optional Courses
Basic Operations	mandatory	mandatory
Information Technology	mandatory	email mandatory, web design optional
Evaluation of Software	some subject methodologies	some subject methodologies
Pedagogical Issues	some subject methodologies	some subject methodologies
Values and Ethics	none	none

Although many of the required CPT competencies are currently addressed in the Faculty of Education curriculum, how students learn, practice and apply technology is not entirely integrated. Students take courses in general education (foundations, curriculum, and pedagogy) subject methodology and subject content. The Faculty of Education has no control over the way the Maths or English departments teach their classes or whether a student will see their literature lecturer use technology in the classroom. It may then come as no great surprise that the student does not see the value of retaining the technology skills to apply in their own literature class several years from now.

Although academic policy of the University of Sydney states the value of information skills (Section 5.a, May 1997), it does not specify how technology must be integrated in instruction, learning and assessment across the curriculum. An integrated approach amongst as well as within the faculties is crucial — although highly unlikely — for achieving objectives in cross-disciplinary study. Students will encounter campus wide computing facilities as well as information technology support through the library system but that does not guarantee that they will actually see technology used for instruction. Additionally the university is considering developing two-day modules of technology instruction delivery for all entering students. Although this is still being developed the Faculty of Education may opt to retain its current structure to teach basic technology skills.

Directions and Response of the Faulty of Education

The Faculty of Education had already enrolled, and provided one semester of instruction, to its undergraduate class of 2000 by the time the report was released. In order to accommodate the mandates, students may have to take a bridging course at the end of their degree. Since the masters class of 2000 has not been admitted yet, there is some flexibility to adjust an already dense program to accommodate the changes.

Most undergraduates begin the BEd and their mandatory computer training within months of finishing high school. It may be more appropriate to teach them self-centred rather than classroom-centred computer skills (i.e. how to electronically research an essay rather than how to use a spreadsheet to make a grade book) in order for them to become familiar and adept with technology. One model of providing, reinforcing, and updating skills during their university degree would be to provide word processing and on-line research skills in Year One; graphics, scanning and multimedia use in the second; spreadsheets, databases and software evaluation in the third; and web design and construction in the fourth and final year. These would be mandatory twelve hour courses and students would have the option of electives that delve into presentation software

and the myriad of computer resources available to assist honours research. While these changes may accommodate the alterations necessary to adhere to the CPT recommendations, a bridging summer or winter course may be necessary to assist students who have already begun their degrees and whose regular semester schedule cannot adapt to additional courses.

Since the MTeach is a new two-year program, it will need a different solution. The MTeach has more incoming students with basic computer skills from their undergraduate degrees and work experience but it also has many mature age returning students with high levels of computer anxiety and low levels of prior skills and exposure.

Conclusion

The genesis and form of the report offers insight to how the relationship between those who train and those who employ teachers has evolved in New South Wales. It also demonstrates what technology skills employing authorities now deem to be necessary and desirable for beginning teachers. What has not changed during this time is the need to learn by example in order to connect theory and practice. If students do not see an integrated, consistent approach to the application of education technology in their teacher education they may not apply it in their own teaching. If technology is seen as peripheral or a skill to tick off in a box in the overall teacher certification degree, they will almost certainly pass that attitude on to their students.

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The Roles of Computers in Education: What Are the Perceptions of Malaysian Vocational and Technology Teachers

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In the early 1980s there were about 300,000 computers in the elementary and secondary schools in the United States. A year later the number had tripled and has been rising ever since (Office of Technology Assessment, 1988). As reported by the Office of Educational Research and Improvement (1986), almost 99% of all public schools in the United States have purchased microcomputers. Recently, a study by the Office of Technology Assessment (1995) estimated the students and computer ratio in the U. S. schools was about 9 students for every one computer.

The scenario in Malaysian schools was quite different from the schools in the U. S. In Malaysia, computers were first introduced into the secondary schools in 1983. Initially, 20 schools were selected for the pilot project. However, 15 years later studies have shown that there are schools with no computers (Ab. Rahim, 1995). Lately, the Ministry of Education has increased efforts to equip every school in Malaysia with computers. Nowadays, some of the schools in Malaysia are linked to the Internet services. Besides the Ministry of Education, the Ministry of Youth and Sports is also doing its part in educating, especially out-of-school youths to acquire knowledge about and skills in using computers.

Computer technology literacy is an important necessary skill to have. According to Bork (1985), computer technology will be the dominant mean of delivering knowledge over the next 25 years. As computers continue to proliferate in our society and influence our lives, naturally everybody will be expected to be computer literate. Nowadays, computers are widely used in almost all professions all over the world. Thus, parents would like to see their children have basic knowledge and skills in computing in order to have competitive edge when entering the computerized world of work. The responsibility to equip children with computer knowledge and skills will be shouldered by schools and many schools are feeling the pressure. Starr (1996) asserted parents wanted schools to use computers to prepare their children for good jobs and a career.

One of the factors that determine the success of computer integration in education is the teacher's perception about the usefulness of technology. The purpose of this paper is to share the findings of a study about the importance of computers in education as perceived by Malaysian vocational and technology teachers.

Objectives of the Study

The objectives of the study were to:

- identify the perceptions of Malaysian vocational and technology teachers with regard to the roles of computer technology in education;
- identify the status of computer technology integration by the Malaysian vocational and technology teachers in vocational and technology classrooms;
- identify teachers' willingness to integrate computer technology in their teaching; and
- assess the relationship between teachers' perceptions of the role of computer in education with selected variables such as gender, prior training in computer technology, general knowledge about computer, and school location.

Methods

The study employed a correlational research design. The sample consisted of 270 randomly selected vocational and technology teachers from three states in Malaysia (Selangor, Negeri Sembilan, & Melaka). All the three states are located in the vicinity of Multimedia Super Corridor (MSC).

The instrument to procure the needed information consisted of sections on (1) the background of the respondents, (2) the general knowledge about computer, (3) the roles of computer in education, and (4) skills in using computer technology. Three teacher educators in the Department of Education, University Putra Malaysia examined the instrument for face and content validity. The

research instrument was pilot-tested for the reliability estimates. The reliability estimate of the general knowledge section as ascertained by KR-20 was .80. The reliability estimate of the section on the roles of computer in education as ascertained by the Cronbach alpha (a) estimate was .88, and the reliability estimate of the section related to skills in using computers was .85.

Research questionnaires were mailed to 270 selected teachers. Of the 270 questionnaires mailed, 140 were answered and returned. It has resulted in 51.8% response rate. Of the 140 returned questionnaires, 111 of them were found to be useable.

Results

Respondents' Backgrounds

The respondents consisted of 37.8% female teachers and 61.3% male teachers. One of the respondents did not indicate gender. The mean age of the respondents was 34.9 years old (SD.=5.85). They have been in the teaching profession between 1 and 22 years with a mean of 5.88 years. The respondents taught subjects such as economics (20%), accounting (28.3%), home economics (6.4%), commerce (19.1%), and agricultural science (15.5%). The respondents indicated that they were teaching in rural areas (36.9%), small town (37.8%), and big town (23.4%).

Teachers' General Knowledge and Skills

Teachers' general knowledge about computers was assessed using 11 questions (Table 1). For every correct response a score of one was given and for every incorrect response a score of zero was given. The scores on the general knowledge about computers ranged between 0 and 11 with a mean of 6.73 and a standard deviation of 2.97. Teachers' knowledge about computers was organized into three categories: low knowledge (score less than 4), moderate knowledge (score between 4 and 10), and high knowledge (score above 10). The study showed that 38.2% of the respondents have a low knowledge about computer, 43.8% of the respondents had a moderate knowledge about computer, and 18% of the respondents had a high knowledge about computer (mean=6.73, sd.=2.97).

Besides asking their knowledge about computers, the respondents were asked how skillful were they in using computer software such as programming language, word-processing and desktop publishing, electronic spreadsheet, and database management (Table 2). The study showed that the respondents could not do programming, 50.8% were not capable of using word processing and desktop publishing software, 67.9% were not capable of using database software, and 57.1% were not capable of using electronic spreadsheet software.

Extent of Computer Integration

Most of the respondents did not integrate computer technology in to their teaching (72.7%). However, the respondents thought computers should be used in teaching vocational and technology subjects (65.1%). Although vocational and technology teachers did not integrate computer technology in their teaching, they planned to do so in the near future (76%). To accomplish it, they planned to attend training to acquire knowledge and skills in computing.

Table 1.
Teachers' general knowledge about computers (n=111)

Computer related questions	Percentages of correct response
Two types of floppy disk commonly used are 5.25 inch and 3.5 inch	74.8
Screen image is made up of pixels	51.4
Modem is a device connecting a computer with a telephone line	62.2
Joystick is a special device enabling the user to touch graphic image on the screen	39.6
Microprocessor is the brain of a computer	58.6
Printer is an input device	58.6
Hardware is part of the computer that can be touched	63.1
A disk has to be formatted before use	82.0
A>B means a disk in drive B is to be formatted	74.4
DISKOPY A: B: means all file contents in drive B are copied into disk in drive A	32.4
The name of a file to be saved must have an extension	31.5

Cumulative scores ranged between 1 and 11 (mean=6.73, sd.=2.97)

Teachers' Beliefs

Eleven statements were constructed to assess teachers' perception about the role of computers in education (Table 3). The reliability estimate of the eleven statements was a .88. The cumulative scores of the teachers' perceptions about the roles of computers in education ranged from 11 to 55 with a mean of 42.6 and a standard deviation of 5.83. In general, vocational and technology teachers have positive perceptions about the role of computers in education. Their perception was categorized as negative, positive, and very positive. The findings indicate that 8.1% of the respondents had a negative perception (scores <36.78), 80.2% had a positive perception (scores ranging between 36.78 and 48.42), and 11.7% had a very positive perception about the role of computers in education (scores >48.42).

Correlational Analysis of Factors

One of the objectives of the study was to assess if there were any relationship between perception of the role of computers in education with selected variables such as: (a) gender, (b) prior training in computer technology, (c) general knowledge about computer, and (d) school location. There was no correlation between the perception of the roles of computers in education with gender (r_{pb}=.11, p=.27); prior training in computer (r_{pb}=.13, p=.20); location

of school (r_{pb}.08, p=.39); or general knowledge about computers (r=.09, p=.41). Regardless of the differences in their backgrounds, vocational and technology teachers in Malaysia in general, have positive views about the roles of computer technology in education.

Table 2.
Teachers' perceptions of their levels of skill in using computer

Types skills	Levels of skills (%)		
	Very skillful	Less skillful	No skill
Word Processing & Desktop Publishing			
Designing a document	13.5	36.0	48.6
Setting margin	12.6	30.6	54.1
Setting tab	18.9	27.9	52.3
Deleting text	26.1	28.8	44.1
Inserting text	20.7	30.6	47.7
Cut and paste	23.4	30.6	45.5
Copy text	24.3	32.4	48.6
Search and replace	16.2	28.8	53.2
Aligning text	10.8	30.6	54.1
Spacing text	22.5	27.0	47.7
Indenting paragraph	16.2	30.6	51.4
Styling	11.7	30.6	55.9
Editing spelling	18.9	32.4	47.7
Numbering page	24.3	29.7	45.0
Sorting and merging	12.6	30.6	55.9
Design and use graphic	03.6	35.1	60.4
Page layout	13.5	34.2	51.4
Inserting graphic	02.7	36.6	59.5
Database			
Building database	02.7	20.7	74.8
Design structure of database	02.7	20.7	74.8
Entering data	10.8	28.8	59.5
Changing database structure	07.2	21.6	70.3
Editing	06.3	21.6	71.2
Indexing	04.5	17.1	77.5
Printing report	03.6	18.9	76.6
Appending records	06.3	20.7	72.1
Copying file to another database	01.8	22.5	74.8
Sorting records	04.5	16.2	78.4
Updating selected records	06.3	14.4	78.4
Merging two database	00.9	18.9	79.3
Electronic Spreadsheet			
Data handling	10.8	19.8	68.5
Changing worksheet appearance	10.8	20.7	67.6
Entering data	13.5	24.3	61.8
Drawing a line graph	08.1	22.5	68.5
Use format command	16.2	27.0	55.9
Use mathematical and statistical functions	24.3	27.0	47.7
Generate report	06.3	28.8	64.0
Use copy command	18.9	31.5	48.6
Use search function	06.3	29.7	63.1
Use logic function	02.7	25.2	71.2
Use window operation	09.0	27.0	63.1
Handling texts and files	09.0	26.1	63.1

Table 3.
Means and Standard Deviations of Vocational and Technology Teachers' Believes about the Role of Computers in Education

Roles of Computers	Mean	SD
Computers can motivate students to learn	4.21	.74
Computers improve teaching effectiveness	4.09	.91
Computers cause more problems	2.21	1.01
Computers bore students	1.99	.97
Computers reduce interaction among students	2.71	1.04
With the computers it is possible for me to guide weaker students	3.44	1.04
Computers create opportunity for good students to excel in their learning	4.28	.79
Computers are useful teaching tools	4.19	.87
The use of computer helps develop a student's self-confidence	4.09	.86
The use of computer in teaching will increase a student's academic achievement	3.91	.93
Using computers may decrease my interaction with students	2.55	1.17

item mean=3.44; scale: 5 (strongly agree); 4 (agree); 3 (moderately agree); 2 (disagree); 1 (strongly disagree)

Discussion

Computers will play a significant role in the delivery of education. As Bork (1985) indicated, in the next 25 years computer technology will be the dominant mean of delivering knowledge. Thus, teachers have to become computer literate if they are to function as educators of the 21st century. In the future the role of teachers will change. They will have to impart knowledge as well guide students to retrieve knowledge from various sources. They will need to equip students with computer technology skills to enter the world of work that will be more challenging and more competitive. As shown in the study the majority of the teachers do not have a good command of knowledge about computers and related skills. But, they were positive about the roles of computers in education. They were willing to use computer technology in their teaching even though they have not been doing so. Their positive views about the roles of computers and their willingness to integrate technology in teaching were further strengthened by their willingness to attend training to acquire knowledge and skills in computing.

With the positive perception of the roles of computer technology in education, integration of computer technology into the classroom will be much easier. However, we have to be very cautious here. We can have teachers with an adequate amount of computer knowledge and skills, but if they are not supplied with hardware and software, the integration will not take place at all. So, facilities and human resources will have to complement one another. Therefor, to assure that the integration of computer

technology into the classroom will occur, the government, through the Ministry of Education, has suggested that all teacher trainees in teacher training colleges and universities be given adequate training in computer technology. The teachers have to acquire the computer knowledge and skills while the government will equip schools with the necessary computer hardware and software.

Conclusions

The following conclusions based on the findings were:

- The vocational and technology teachers in Malaysia who participated in the study teach economics, home economics, accounting, commerce, and agricultural science.
- About 43% of the respondents had a moderate knowledge of about computers. Almost one-half of the respondents were not able to do programming. Almost one-half of them were not capable of using word-processing. Two-third of them were not capable of using database management program, and about one-half of them were not capable of using electronic spreadsheet program.
- Majority of the respondents did not integrate computer technology in their teaching but they were willing to do so in the future. Majority of them will try their best to acquire knowledge about and skills in using computers.
- Most of the respondents had a positive perception about the roles of computers in education.
- Teachers' perceptions about the roles of computers in education did not correlate with any of the demographic variables investigated.
- Based on the findings, it is believed that the integration of computer in classrooms will be successful provided teachers have the knowledge and skill in using computers and the availability of computer hardware and software.

Recommendations

1. All teacher education programs in Malaysia should include in the teacher training curriculum, at least one compulsory course on using computers in the classroom.
2. Inservice courses should be conducted on a regular basis to equip teachers with the latest knowledge about and skills in using the latest computer software.
3. The school administration should encourage all teachers to acquire knowledge about and skills in using computers so that it is possible for the teachers to integrate computer technology in their teaching.
4. All schools should have computers if we want to make the integration of computer technology in the classroom a reality. The number of computers should be adequate to provide every student with an opportunity to use the technology.
5. Computer technology should be used in the classroom to prepare the Malaysian workforce for the information age technology.

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Assessment of Computer Education for Pre-Service Secondary School Teachers

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Owing to the advancements in computer technology and the general availability of the computer network, the manner in which we obtain information, process information and use information will change significantly from the pre-computer, pre-network age. Consequently, the twenty-first century has been dubbed the information age.

To better prepare the next generation for the future, many universities and colleges offer computer literacy courses to non-computer related majors. However such courses were often conducted as an application literacy course. In such a class, students often come away only with the knowledge of a few application software packages. On the other hand, if the lectures were too theoretical, students would deem it as being dull. Our view toward such a course is consistent with other educators in that computer literacy is as important as application literacy. And both types of literacy need to be taught. Many reports and published papers support this view (Curl & Hussin, 1993; Goldweber, Barr, & Leska, 1994; Price, Archer, & Moressi, 1994). The "Revitalizing the Computer Science Course for Non-majors" panel (Burd, Brookshear, Decker, Gustavson, Lintner, & Scragg, 1995) of the 26th ACM-SIGCSE conference in Nashville also touched upon this issue. However, effectiveness of such courses was often reported only as an observation rather than as formal studies. In this article, we present our assessment of the computer literacy course that we have conducted over the years.

In the remainder of this paper, we briefly described our implementation of the Computer Education course, which is required for almost all majors at our University. Full details of the course design philosophy and the actual implementation can be found in Lee and Wu (1997). A formal assessment scale (Selwyn, 1997) was used to evaluate student's attitude toward using computers after only one semester of our Computer Education course. Moreover, we also report on the students' written feedback over the conduct of this course. In both cases, the results were most encouraging in that the students enjoyed the class and their attitudes toward computers are on the positive side.

Computer Education at NTNU

National Taiwan Normal University (NTNU) is one of the best-known and highly praised universities in Taiwan. NTNU competes with the other leading universities for the top 5% students of the annual nationwide joint college entrance examinations. Like others, NTNU prides herself in cultivating a sound body and mind as well as the academic development of all students. What sets NTNU apart is her status as the major university in training secondary school teachers. At NTNU, students receive the same rigorous training in terms of course works in their respective majors as with students in other universities. In addition, 26 credit hours of pedagogical theory courses are required for teacher certification. *Computer Education* is one of those pedagogic courses. Seventeen of 22 degree programs have listed *Computer Education* as a required course and the remaining departments list it as an elective course. Therefore, it is most likely that a NTNU student will have *Computer Education* on their transcript before graduation. The course is most often offered as a sophomore level course.

In summarizing terms, students of this course are non-computer science majors with little or no previous computer experience. They are most likely to hold a life-long career as secondary school teachers and thus they are most interested in becoming computer literate in terms of basic operations of the computer, usage of commonly available software, and working knowledge of computer networks. This course is designed with those objectives in mind.

The course contents are divided into four groups of topics:

- *Basic Computer Concepts:* hardwires, operating systems, file management, Chinese input methods
- *Computer Networks:* introduction to Internet, Email, Talk, Gopher, BBS, News, WWW, FTP

- *Popular Application Packages:* Windows, Paint, MS-Word, Excel, Power Point
- *Demonstrations of VCD Titles:* Computer Assisted Learning titles

One third of the semester is spent on the basic computer concepts and its operations. *Basic computer concepts* serve as a foundation for becoming computer literate. Both the hardware and the software aspects were discussed. Furthermore, time was also allotted for topics on computer viruses and on the copyright laws for computer software.

Computer networks and *popular application packages* build on the fundamentals to bring the students up-to-date on the current computer technologies and to use these technologies effectively. As part of Taiwan's National Information Infrastructure Plan, the Ministry of Education has set aside funds to allow all the secondary schools to have direct access to the Internet within the next few years. Furthermore, new computers equipped with Microsoft Windows and its line of products will continuously be added to all the secondary schools. Thus it is important for the teachers to learn how to navigate the Internet, to use the resources available on the net, and to be comfortable using popular software packages. The goal on *application packages* was not to make master users out of the students on any particular software. Rather, students should acquire a working knowledge of different types of software. In so doing, when encountering a problem, students will be able to decide on which software to use and to learn in depth if necessary.

Finally, to better relate the message that the computer is a useful educational tool, it is important that students be exposed to software related to their major studies. Furthermore, quality CAL CD-ROM titles can be used to give the students a sense of how computers can make learning fun.

Pedagogical Issues

Computer Education is a two-credit course that meets for two consecutive hours every week. Since no extra laboratory time was scheduled, we conducted our classes in microcomputer laboratory for ease of class demonstrations. Each week, approximately 60 minutes to 90 minutes of time were spending on lectures and demonstrations of the topic of the week. The remaining time was for students to practice or complete in-class assignment.

The microcomputer laboratory is equipped with 45 Intel Pentium based networked PCs all and is also connected to an instructional broadcast system. This ensures that all students have the same software setup. The broadcast system allows for teacher-to-all, student-to-all, and student-to-teacher modes of broadcasting. With the teacher-to-all mode, all the monitors in the laboratory are synchronized with the instructor's PC monitor. As such, all students will see the operating commands being entered, either via the keyboard or the pointing device, and the consequences of those commands.

During the semester, homework is assigned in each of the 18 weeks. Each homework assignment is associated with the topic covered that week and computer usage is always involved. To ensure that the assignments are fun and interesting, and to discourage academic dishonesty, each assignment is designed so that students are required to express their own creativity or to interact with the instructor and/or their classmates via the computer network.

Assessments of Attitude towards Computers

One of the goals of this course is to cultivate students' interests in computers. To understand if that goal has been reached, we conducted a survey to measure students' attitudes towards computers at the end of the semester. Our scale is based on Selwyn (1997), that was reported to have good reliability and validity, and to have satisfactory internal consistency. The scale contains 21 questions in 4 dimensions: *affective* - feelings towards computers; *perceived usefulness* - the degree to which one believes using computers will enhance their job performance; *perceived control* - perceived easy or difficulty of using computers; and *behavioral* - behavioral intentions and actions with respect to computers. The questionnaire is accompanied by a five-point Likert response scale (worded "Strongly Agree", "Agree", "Neutral", "Disagree", and "Strongly Disagree"). Scores ranges from 4 (Strongly Agree) down to 0 (Strongly Disagree). Thus students' overall score could range from 0 to 84. As with Selwyn, we alternated questions from each dimension to prevent "clustering" effect. Furthermore, 10 of the questions were negatively worded to prohibit students' giving all positive or negative responses. The questionnaire is given in Table 1.

The questionnaire was administered to three classes of 116 sophomores enrolled in authors Computer Education course. A Cronbach's coefficient ? was calculated to collect the reliability data of our Chinese version scale. The result as depicted in Table 3, shows that the ? coefficients were suitably high for the overall scale as well as for each sub-scale (dimension) suggesting satisfactory internal consistency of the scale.

From the perspective of the students' raw scores (summing up the score on all questions), the scores ranged from 22 to 78. Using the normative guide obtained by Selwyn (1997) as given in Table 2, 68.1% of our students would deem to have a positive attitude toward using computer, while only 2.6% of the students have a negative attitude after taken this course. Scores along the four dimensions are depicted in Table 3.

Table 1.
Assessment Questionnaire as in Selwyn (1997)

Dimension	N	Question
AFF1	1	If given the opportunity to use a computer, I am afraid that I might damage it in some way.
USE1	2	Computers help me to organize my work better.
CON1	3	I could probably teach myself most of the things I need to know about computers.
BEH1	4	I would avoid taking a job if I knew it involved working with computers.
AFF6	5	I hesitate to use a computer in case I look stupid.
USE5	6	Computers can enhance the presentation of my work to a degree that justifies the extra effort.
CON4	7	I am not in complete control when I use a computer.
AFF3	8	I don't feel apprehensive about using a computer.
CON2	9	I can make the computer do what I want it to do.
BEH3	10	I only use computers in school/college when told to.
CON5	11	I need an experienced person nearby when I use a computer.
AFF5	12	Using a computer does not scare me at all.
USE4	13	Most things that a computer can be used for I can do just as well myself.
BEH2	14	I avoid coming into contact with computers in school/college.
CON3	15	If I get problems using the computer, I can usually solve them one way or the other.
AFF2	16	I hesitate to use a computer for fear of making mistakes I can't correct.
USE3	17	Computers can allow me to do more interesting and imaginative work.
BEH4	18	I will use computers regularly throughout school/college.
CON6	19	I do not need somebody to tell me the best way to use a computer.
AFF4	20	Computers make me feel uncomfortable.
USE2	21	Computers make it possible to work more productively.

AFF - affective, USE - perceived usefulness, CON - perceived control, BEH – behavioral

From the Table, we may conclude that students generally have a positive attitude along the *perceived usefulness* and *behavioral* dimensions. The average score of 3 (Agree) means that students now perceive computers as being useful and is willing to use computer to enhance their work. Along the *affective* dimension, the average score of 2.55 falls between "Agree" and "Neutral" in the Likert scale, meaning that students has a somewhat positive feeling toward computers, but not strongly. Further analysis reveals that questions AFF1 and AFF3 have averaged only 2.1 and 2.0 respectively. As far as *perceived control* goes, the average of 2.08 (Neutral) is to be expected. We submit that one semester of computer education course is not enough for students to feel in total control of the computer, which also explains the not so high score on questions AFF1 and AFF3.

Table 2.
Distribution of the Overall Score.

Score	N	%	Selwyn (1997)
0 – 35	3	2.6%	negative attitude towards computers
36 – 42	12	10.3%	
43 – 50	22	19.0%	
51 – 84	79	68.1%	positive attitude towards computers

Table 3.
Scores on Students' Attitude toward Computers and the Reliability of Data.

Constructs	Mean	Standard Deviations	Cron-bach?
Affective attitudes toward computers	2.56	1.07	0.84
Perceived usefulness of computers	2.92	0.87	0.73
Perceived control of computers	2.08	1.02	0.79
Behavioral attitudes toward computers	2.94	0.82	0.84
Overall scale	2.58	1.03	0.88

Feedback from Students

To better qualitatively evaluate the success of this course, we asked the students to fill out a feedback form on what and how much they had learned. In addition, comments about the course, about the lectures and about the teaching methodology were welcomed. To encourage true feelings about the course, the feedback forms were not returned to us till the grades were out. The most often cited comments naturally falls into two groups as detailed below.

Best Parts of the Course

Course Contents Are Practical and Useful. Most of the students mentioned that the course contents are just what they needed for the remaining years in school and beyond. Many have begun using what was taught in class

in their school works. Among the topics covered, the weeks spent on computer networks were most welcomed.

Having Hands-on Practice Time during Lecture. Because no lab hours were scheduled for this course, conducting the lectures in a microcomputer lab and interweaving lectures with hands-on practices in the same class period were cited by students as a major reason for the success of this course. With the in-class practice time, major concepts and operational skills can be better mastered, which in turns could save much time when completing the weekly homework assignment. Several students suggested that the in-class practice time should be increased.

Demonstration of CD-Titles. The demonstration of educational CAL CD-Titles was well received by the students. The students liked the chance to experience computer multimedia and were fascinated by how much fun it can be with computer assisted learning.

Interactions with the Instructor Are Good. Many of the homework assignments require interactions between the students and the instructor through the computer network. For example, the homework on e-mail asks the students to complete a rather simple task. However, the process naturally requires the students to communicate with the instructor through e-mails. This strengthens the teacher-students relationship, which enables more interactions inside the classroom.

Complaints, Suggestions, and Future Improvements

Problems with the Computer Equipment. During the course of the semester, due to unexpected hardware malfunctions or computer viruses, some students had to share a computer with one another. The problem is unavoidable for the computer lab was open to the general public. Possible remedies include teaching the students trouble shooting techniques and installation of anti-virus protection software and hardware.

Too Many Homework Assignments. The most frequent complaint from the students were over the number of homework assignments. However, we firmly believe that doing homework is the best way to become computer literate. Thus, we do not plan to change our stance on this issue in the future.

Obsolete Technologies Are Not Useful. To give students a whole picture of how technologies have evolved, we sometimes introduce how things used to work a few years back. For example, the DOS operating systems and the FTP line commands. Nowadays many operations and applications all have user friendly interfaces. Perhaps in the future we could lessen the time allotted to those topics.

Lack of Textbooks. It is rather difficult to find a single book that covered all of the topics that we covered. In the future, we plan to make available lecture notes on the web for the students to browse at their leisure.

Increase the Allotted Time on Networks. Because the weeks on computer networks were best appreciated by the students coupled with the strong desire to learn more about the computer networks, we intend to increase the proportion of time on Networks. This would coincide with the Ministry of Education's plan to have all secondary school teachers learn to use computer network and to learn it well.

Summary

In this paper we reported on the successs of a computer literacy course delivered to preservice secondary teachers. The topics covered were chosen to ensure that students will become both computer and application literate by the end of the term and that the applications packages so selected prepare them for their future career as secondary school teachers.

From the assessment of students' attitudes at the end of the term, we conclude that not only have the students become more computer literate, they have even developed positive attitudes toward learning to use computers. The success of teaching a course such as ours can be attributed to the following reasons:

- The course content relates to the practical applications of computers and to students' future teaching careers.
- In-class hands-on guided practice sessions make the lectures more interesting and makes it easier to master the topics covered.
- Regular homework assignments reinforce the skills acquired in class.
- Good interactions between students-teachers and students-students makes a less pressured and thus a better learning environment.
- A well-equipped computer lab with good instructional tool such as broadcasting systems enables the teacher to better communicate and show the operational aspects of computer literacy.

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Technology Enhanced Learning Initiative in Southern Africa

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The difficulties in Africa of gaining access to education and development are well reported. The existing poor standard of communication in many parts of Africa adds to the difficulties of improving the quality of education and standard of living on the continent. Distance education is seen as a key to the broad improvement of education standards in Africa. The notion of flexible learning is rapidly gaining respect that opens more avenues to intra-continental collaboration between all educational institutions.

With rapidly improving access to telecommunications across the continent, educational institutions and learners may now gain improved access to sources of programmes that will enable them to study without leaving their home cities and countries. Concerns of the present and past of the most talented citizens who study abroad and then never return to benefit their mother countries may be reduced through the effective use of combinations of the computer, Internet, satellite television, and other modern and developing technologies.

A number of factors, are appropriate on the continent, need to be taken into account in the enhancement of education using Internet technologies. Access to telecommunications is both limited and costly and it is primarily these that need to be harnessed to improve the skills of educators and learners. By a coordinated approach one can improve access of learners and institutions to telecommunications, support learning materials and expert discussion and advice. The many efforts in this regard on the continent need to be seen within an overall framework for the purpose of advancement and upliftment. This plan provides that framework and identifies additional areas where specific lead projects need to be accelerated or initiated to provide for the next stage of development the continent needs.

This plan has been drafted taking cognisance of the recent policy research documents on technology enhanced learning published by the South African Department of Education and fully support the implementation on the strategic planning document. The authors wish to see that technological support is provided from specific countries initially and then expanded to support other countries in the SADC region. This plan should be seen as complimentary to other initiatives in Africa, especially that of the African Virtual University and the flexible learning projects on the continent.

The intention is to initiate co-operation amongst countries in the SADC region in their renewal and expansion of education through the use of appropriate, available and cost effective technologies. Beneficiaries of the plan will be learners throughout the region being able to gain access local teachers and lecturers who have been able to improve their skills through professional development programmes on the Internet. Communities will be able to benefit through their improved skills and communication powers in the marketing of their products and services internationally. They will be able to gain from expert advice in other countries and offer advice on experience gained in their own areas.

Overview of the Plan

The plan comprises a number of strategic thrusts each of which needs to be started concurrently (see Figure 1). The project components, detailed in the next section are briefly outlined below:

Community Forum Programme

The southern African community forum programme is a framework through which local community structures may be involved in the process. It is expected that full community level support will be needed to implement all aspects of this plan (See Figure 1: Community Forum Programme).

Project Plan for Information

The project plan for information comprises initially two information clearing houses which will be created in a form of Internet web servers which may be located in South Africa and Zimbabwe. These will be expanded to other countries in Africa (or outside Africa) as the plan unfolds. The location of the Internet web servers contain-

ing information will have to be determined by the level of Internet infrastructure, speed and reliability of access by potential users (learners and learning facilitators). These information clearing houses will contain support material for primary, secondary and tertiary level education as well as an index of hyperlinks to sources of appropriate information. A section of the server will be dedicated to continuous education aimed primarily at the upgrading of educator's skills.

Materials must be made available in a format that enables course materials to be transferred via the Internet while attached to e-mail messages or being viewed on the World Wide Web. Specific programmes available for non-profit and educational use will be utilised for this purpose.

This section of the plan also links to the establishment and development of various centres of excellence in member countries. Centres will vary in nature and learning content depending on national priorities as determined by the respective national departments of education. Examples may be the Malawi Institute of Management (MIM), Eastern and Southern African Management Institute (ESAMI), Institute of Public Administration in Gaborone.

Plan for Internet Connectivity

Access to the information stored in the information clearing houses will only be of benefit to those institutions and individuals able to access the Internet (Plan for Institutional Connectivity). Two sub-strategic thrusts seen to be necessary in this area are: 1) to be the raising and marshalling of funds to support and 2) the necessary infrastructure in all countries in southern Africa. Connectivity will remain constrained by the availability of telecommunication as provided by the national telecoms. The supply of electricity which also remains a constraint can be overcome to a limited extent with the use of alternative sources of electricity such as generators (fuel and solar) and batteries. Internet connectivity is likely to remain largely in the hands of the commercial sector and government agencies.

While the infrastructure for institutions may be linked to the overall Internet connectivity within each country, learners need to be taken care of very specifically (Plan for Learner Connectivity). On-line libraries and learning centres are necessary to support those students who do not have access to computers and the Internet. Internet connectivity through Internet Service Providers (ISPs) may be encouraged through collaborative ventures with the private sector.

Plan for Training of Educators

All of the preceding aspects of the plan are dependent on the ability of educators in the region to access and use the available information. For this reason an educator training programme in the use of computers and the Internet is required even before they are able to access the information clearing houses (Plan for the Training of Educators). Facilitators will need to be trained who can then operate at country, provincial and community levels to provide the basic training required to enable educators to use their institution's Internet connections to gain further continuing education programmes via the information clearing houses.

It will be seen that each of the five strategic thrusts of the plan need to be undertaken concurrently so as to minimise the implementation period. Each participating country will need to have a full-time project team appointed by its department of education to coordinate the various activities at provincial and local levels. The implementation of the strategic thrusts is outlined in more detail below.

Figure 1. Technology Enhanced Learning Initiative in Southern Africa (TELISA).

Description of the Strategic Thrusts

Project Plan for Information

The Project Plan for information (see Figure 2) involves the establishment of a series of information clearing houses based on the Internet and centres of excellence to be located in a number of major cities throughout the southern African region.

Centres of Excellence

The Centres of Excellence are a series of high quality educational institutions to be located in cities such as Lilongwe, Windhoek, Gaborone, Harare and Pretoria. These will concentrate on the provision of high quality courses in such areas as science, technology and business related to prepare learners for careers and further studies in these fields. This concept finds one model in the Brooklyn School of Science and Technology in New York whose former students have won some five Nobel prizes since its inception 14 years ago. Such centres of excellence will

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usually be existing institutions that are leaders in a particular field.

Figure 2. Project Plan for Information.

Information Clearing Houses

The Information Clearing Houses are to be based primarily on the Internet and will comprise a sufficiently powerful Internet server connected to the Internet through high-speed data communications links. The four major functions of the Information Clearing Houses will be that of providing supportive course material for primary, secondary and tertiary level institutions, a comprehensive set of global hyperlinks to assist teachers and lecturers in obtaining materials for their teaching, and continuous education programmes to support primarily professional development of educators and various business and community related programmes.

It is envisaged that the Information Clearing House will be a wealth of information and to provide access to information that will be of great value to teachers and lecturers throughout the region. Programme content may vary from Internet based hypertext materials, to multimedia and broadcast programme materials.

Where materials are in hypertext format, lectures, tutors and learners will be able to access information by e-mail by sending messages to an archive facility on the Internet server. The server will be programmed to respond automatically by returning the required file, usually in html format (hypertext mark-up language) plus all appropriate graphics attached to an e-mail message. Graphics will be formatted to require minimum download times and materials are to be created with only those graphics that add value to the study material. Users with Netscape Mail or similar e-mail program will then see fully formatted text and graphics in their e-mail that may studied in e-mail format or printed if required. The relevant html files and graphics may also be saved separately from the message on local PCs or servers to save further telecommunications expenses.

Broadcast technologies are incorporated into the plan via the Clearing House of Information from the following perspective: Information on programmes being broadcast by television, radio or other form of broadcast techniques. Programmes may then be viewed using the required equipment. Where individuals need to collaborate to access the equipment, this may be done under the Plan for Connectivity. As sufficient bandwidth a storage space becomes available, programmes may be stored on the Information Clearing House and provided to uses on demand (e.g. real audio and real video).

Plan for Internet Connectivity

The Plan for Internet Connectivity (see Figure 3) rests on three "legs". The first of these legs is governmental education departments that need to build the necessary infrastructure for national educational institutions. The second leg comprises those regional organisations such as the Distance Education Association of Southern Africa (DEASA), that strive to improve the standard of education and inter-institutional co-operation in the region. The third leg of this strategic thrust is that of developing the infrastructure which supports the various educational institutions such as the supply of electricity and telecommunications by the relevant national utilities.

Figure 3. Plan for Internet Connectivity.

Regional organisations such as DEASA can serve as a body to assist specific institutions that lack the necessary infrastructure to gain access to the Internet. Once proposals have been drafted for the raising of funds, potential partners need to be identified and approached for assistance. In this way funds may be raised to sponsor the purchase of necessary computer and modem equipment, secure facilities and staff training on the basics of using computers. Such connectivity is not presently included in this plan. Examples of projects already underway in this

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area include ZA Schools (http://www.school.za) and the Acacia Project (http://www.idrc.ca/acacia/acacia_e.htm) and Uninet (http://www.uni.net.za).

Institutional infrastructure is almost entirely dependent on the provision of reliable electricity and telecommunications to the institutions. The infrastructure plan needs to be coordinated at a national level in each member country with the responsible agencies for electricity and telecommunications. With careful liaison adequate facilities may be supplied to individual institutions which will make provision for them to utilise equipment that may be available to them.

Plan for the Training of Educators

Educators who have not been exposed to the Internet or have limited computer knowledge will need to receive hands-on training on both using computers and on how to use the Internet. Although more advanced professional development programmes may be housed within the institutions where the Clearing Houses of Information have been established, the basic training required by educators will need to be provided on a local contact basis.

Figure 4. Plan for the Training of Educators.

An initial programme needs to be developed for the training of facilitators who should emanate from all countries in the SADC region. An initial training programme for these facilitators (see Figure 4) will be run in one venue and then facilitators will return to their home countries where they need to run training programmes for a larger number of facilitators to operate within their country. Facilitators who return home after receiving the basic training will then be expected to run programmes at a national level for their Department of Education, at provincial level and also at community level. Each time a country facilitator runs the programme sufficient skills should be passed on to enable the participants to be able to run the same workshop for others within their community or institution. At community level, the facilitators may work with universities, polytechnics and colleges, thereby helping the integration of these institutions into their respective communities.

Community-based on-line learning and library centres are essential at a local level to help eradicate illiteracy within the sub-continent. These facilities should be given specific support through the Community Development Forum programmes.

Community Forum Programme and Plan for Learner Connectivity

The Community Forum programme is a framework that may be used to encourage community level participation in this and other programmes. The programme needs to be coordinated at country level via an appropriate government department or non-governmental agency (see Figure 5).

Figure 5. Plan for Learner Connectivity.

Community level coordination is required by a member of each participating community which in turn sets about developing a multipurpose information facility which is linked to a telephone shop, should telecommunications not be freely accessible in that particular community. On-line libraries and learning centres are an essential part of giving access to computers and the Internet to students who would otherwise not have any access. These facilities need to be initiated and supported by the community through the Community Development Forum. These on-line libraries and learning centres, in turn, connect via the Internet to the various Centres of Excellence and the Information Clearing Houses. Where a community deems it necessary, additional facilities may be added to a proposal to include facilities to receive programmes via satellite TV (e.g. African Virtual University and the South African Broadcasting Corporation) and radio.

All available course material on the Internet servers of the Information Clearing Houses will be directly available to Community Learning Centres through the Internet and related facilities. Individual learners and groups of learners

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who have their own personal computers may also gain access to the information stored in the Clearing Houses of Information through their Internet service providers.

Initial Projects

As stated at the beginning of this plan, all strategic thrusts should be started simultaneously and if started by December 1997, tangible results may begin to be reported by the middle of 1998.

The plan above does not attempt to offer any "correct" form of technology, but rather a conceptual framework within which many projects may be structured. This is expected to assist institutions and countries in the region in their negotiations and alliance forming to aid community development.

Projects may be included by organisations from across the region and each is to be planned, funded and implemented independently from other projects. The motivation to collaborate through the TELISA Plan to minimise duplication of effort and "planning gaps" will be obvious to the reader.

Project 1: Information Clearing Houses

It is envisaged that initial Internet servers to house the required information should be located in Johannesburg and Harare. The intention is that each of these servers should be placed on a high-speed link to an Internet backbone. It is further recommended that the details for this project be borrowed from the TELI-Strategic Plan of the National Department of Education in South Africa. It is envisaged that the SA Department of Education will install the first Information Clearing House.

Each site should be an exact mirror of every other one, thereby providing for duplicate familiar sites that may be accessed in the event of slow or faulty Internet lines. A commercial directory facility may be maintained to assist with the self-funding of the sites. Educators and learners who have the necessary capacity will be encouraged to contribute to the contents of these sites. While initially English will be considered the language of communication for the clearing house, other languages used in southern Africa may be included based on the requirements of participating countries.

Project 2: Centres of Excellence

These Centres of Excellence should concentrate on the development of skills for top level manpower requirements in each country. The specific subjects taught in each of these Centres must be determined by national priorities within each country.

It is recommended that the draft plans of Professor Casper Schutte at the University of South Africa be used an example by national authorities in the development of these Centres of Excellence.

Project 3: Infrastructure Planning

Institutional Infrastructure. Learners and tutors may only have access to any of the information and expertise if they have the necessary computer and connectivity. It is recommended that a joint team from the region be charged with the responsibility to establish which institutions require equipment before they may participate in the project. The same team should then draft a comprehensive proposal for the funding of all computer equipment, programmes and necessary internal infrastructure such as local area networks, disks, cabling, etc.

National Infrastructure Plans. Institutions may not be feasibly expected to participate in the plan if they do not have a reliable source of electricity and data communications. A separate team from the region must be assigned the task of negotiating the supply of electricity and telephone lines to all institutions involved in the project with the respective authorities within each country. Where institutions are unable to cover the cost of electricity and telephones specifically for their computer laboratories, this should be included in the fundraising proposals created above.

Project 4: Facilitator Training Programme (Courseware)

Facilitators who are to be trained and who return to their own countries to facilitate the training of others will require a comprehensive manual both for their own understanding and to enable them to train other people. A courseware development team must be assigned the task of collating and developing materials for the manual that will be received by all facilitators in the region. This package should include the entire course on print, on computer disk and should also include the necessary minimum programmes required to connect to the Internet.

Project 5: Facilitator Training Programme

An initial training programme of country facilitators must be run in an appropriate venue using the materials developed above. Each trained facilitator will be required to return to his or her home country and offer the same programme to groups of facilitators within that country who will in turn be responsible for training educators in schools and tertiary institutions.

Within each country, training programmes will be required at a national, provincial and community level. Educators within communities who have received this training will then be expected to assist in the cross-training of other educators within their own and other communities.

Project 6: Development of the Community Forum Programme

A basic outline or framework for the Community Forum Programme is required which may be used across all countries in the region and which may be modified as required at local level. A small team needs to be appointed

to review courseware that is currently available and to ensure that this will be acceptable at community level across the region. This programme must be made available in print and in digital format (e.g. MS-Word) and an appropriate version for storing in the Information Clearing House (e.g. html).

Project 7: Community Development Forums

Using the material developed above (Project 6), Community Development Forums must be initiated at a local community level within each country initially on a pilot basis and spreading out in a structured manner. Materials must be made available free of charge from the Clearing House of Information via those institutions that have developed the required technological infrastructure. These Community Development Forums will be expected to develop their own multipurpose information facilities and to assist in the provision of infrastructure including electricity and telecommunications by providing an environment that is conducive to the national commissions responsible for these matters.

Project 8: Establishment of Computer/On-line Learning Centres

A number of initiatives are required across the entire region to create centres to which learners of all ages may go to gain access to computer equipment and access to the Internet. These centres should be based on each specific community's requirements but in general should comprise an appropriate local area network (LAN) with one server and a number of PCs linked to it. Via the server, users should be able to access e-mail and where possible, the world wide web. Private e-mail accounts should be maintained on the server for all regular users of the centre. Sophistication of connection between the LAN and the Internet will depend on local circumstances.

Conclusion

When considering technology as an added instrument to enhance education and capacity development, a holistic view needs to be taken to ensure that the installed technology can be used for the purpose for which it was acquired. Aspects such as the supply of electricity and telephones, training of staff, security of equipment and commitment and acceptance by the user community are all essential.

This plan was the first stage in conceptualising a cohesive way in which multiple projects could be monitored and capacity building effected in Southern Africa. The initial draft was followed by a workshop held in South Africa on 25 September 1997 at which the principles were endorsed. Further documentation is available on the Internet at: <http://vgc.co.za/telisa> that shows the implementation plan and progress to date.

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This document has been drafted in consultation with a number of organisations including:
The World Bank
The Telematics for African Development Consortium
Technikon Southern Africa
Confederation of Open Learning Institutions of South Africa

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Constructivism, Learning Methods and Delivery Media: A South African Tale

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This paper reports a follow-up research project and an in-depth examination of issues raised in "The KwaZulu Concept Burger" presented by Clark and Peté at SITE97. This original study focused on the learning experiences of three students during the cooperative construction of a hypertext concept map. These students are residents of the province of KwaZulu Natal and study towards a Master's degree in Education at the University of Pretoria, Gauteng Province, South Africa. This report is of a qualitative, comparative study that reflects upon the spectrum of learning experiences of all eleven students in the class.

The Master's assignment entailed the construction of concept maps on the topic "The evaluation of educational software and its effect on learning". As stated previously, the creators of "The KwaZulu Concept Burger" (the Burger) delivered their product in electronic media. It was prepared in HyperText Markup Language (HTML) and presented through a World Wide Web (WWW) browser. The other maps produced by cooperative groups took the form of physical representations (models or posters).

Since its construction, the Burger has continued to evolve. The initial product was adapted and used by its creators in their working environment. Other concept maps remained static and unused.

This paper investigates (i) the role the chosen *delivery medium* (HTML) played in the learning process. It further aims to (ii) examine *learning methods* which played a role in the learning process. In order to draw any conclusions concerning the influence of delivery media and methods of learning on the learning processes, (iii) the *development of the other concept maps* are analysed and compared to that of the Burger.

Literature Review of Factors Influencing Learning

The literature review of factors that influence learning included reports on both behavioural and constructivist teaching and learning methods. Articles were reviewed also that looked at the different media that influence teaching and learning.

Teaching and Learning Methods

Behavioural Learning. Behavioural learning follows a pattern of stimulus-response-feedback and reinforcement: "Feedback produced by the consequences of behavior may reinforce that behavior" (Cook, 1993, p. 64). Behavioural learning can be used effectively to reinforce basic subskills, in order to attain "automaticity", which Bloom defines as follows: "The mastery of any skill - whether a routine daily task or a highly refined talent - depends on the ability to perform it unconsciously with speed and accuracy while consciously carrying on other brain functions" (1986, p. 70). These higher-level brain functions include "retention, understanding, and active use of knowledge and skills" (Perkins, 1991, p. 18).

In the long term, behavioural learning fails to attain the brain functions mentioned above by Perkins. It furthermore does not effectively facilitate transfer of learning to broader environments, outside of the traditional classroom: "The knowledge so acquired is either not accessible or else not relevant for active use in the real world" (Barras-Baker: 24).

Constructivist Learning. The constructivist learning process addresses the weaknesses of behavioural learning. In a constructivist learning environment, learners actively construct knowledge from personal experiences and interpretations of the world (Merrill, 1991). Learning becomes an active process when learners develop their own mental models. This process involves "the organising of memory into structures" (Merrill (1990b), quoted in Merrill, 1991, p. 45). Merrill states that organisation in learning facilitates later retrieval of information. Organisation entails the structuring of knowledge. Retrieval can also be aided by learners' use of elaboration, which refers to "the explicit specification of relations among knowledge units" (Merrill, 1991, p.45).

Rich Environments for Active Learning (REALS) are a specific form of constructivist learning, and are based on principles such as collaboration, generativity, reflectivity, active engagement and anchored instruction (Dunlap, 1996).

Teaching and Learning Media

Hypertext. Hypertext is "a generic term covering a number of techniques used to create and view multidimensional documents, which may be entered at many points and which may be browsed in any order" (Illingworth, 1990, p. 212). Hypertext can be used in a variety of ways in an educational learning environment. Materials and resources can be delivered to learners in this medium. In addition, learners can output knowledge through hypertext projects.

In either of the above situations, navigation in a hypertext environment provides the learner with the opportunity to develop multiple perspectives. It facilitates the traversal of complex subject matter in non-linear ways. Multi-dimensional navigation enables learners to make links between concepts. Maximum learner control is made possible in such environments. (Mc Manus, 1996; Spiro, Feltovich, Jacobson & Coulson, 1991)

The Internet and The World Wide Web (WWW). The term "Internet" implies the global inter-connectedness of computer networks of information. Web browsers (such as Netscape and Internet Explorer) enable users to access information available on the Internet through a hypertextual Graphical User Interface (GUI).

The Media Debate. Fourteen years ago, Richard Clark stated that media are "mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (1983, p. 445). Clark's article provides research evidence that methods and media were confounded in the past, and that the importance of methods of teaching are often overlooked. As a result of evidence that "many very different media attributes accomplish the same learning goal", he suggests that "the attributes must be proxies for some other variables that are instrumental in learning gains" (Clark, 1994 p. 22). In addition Clark states that media may "affect the economics but not the learning effectiveness of instruction" (Clark, 1994, p. 26).

In a constructivist learning environment, learners, rather than instruction being "delivered" to them, construct knowledge. In such situations Clark's media would include the means students use to deliver the products of their learning. This paper investigates whether successful transfer of knowledge (or lack thereof) in the case of the Burger and its counterparts, can be attributed to "proxies for some other variables", rather than to the delivery media chosen by the learners.

Execution of Mind Map Projects

Stages of Development of the Burger

The three KwaZulu Natal students sketched the development of the KwaZulu Concept Burger as follows:

During the Master's Module. The original concept map was devised as an examination project for the subject "Evaluation of software and its effect on learning".

Back at Work. After the students submitted the Burger as an examination project, it was continuously updated as it was used in their professional practice. It formed the basis of a variety of workshops presented at tertiary institutions. In addition, educational technologists continued to access the Burger on the Internet, using it to evaluate multimedia products. The Burger was eventually presented at the SITE 97 conference in Orlando, USA.

How the WWW Influenced the Learning Process of the KwaZulu Natal Team. The following information was obtained from on-line questionnaires completed by the students:

Effortless and cost-effective updates were facilitated by the dynamic medium of HTML.

As time passed since the Burger's initial construction, HTML editors became more sophisticated, and their added features (e.g. capability to produce tables) were used to improve the product. The technical improvements enhanced the illustration of important concepts such as the evaluation matrix.

The WWW played a dual role in the Burger creators' learning process: it served as construction tool as well as a content provider in the continuous process of improving the product and writing the conference paper.

The need for retention of information became less important in the learning process, as the Burger's creators and other users could access it at any time on the Internet.

In preparing for presentations, knowledge gained in practice was used to update the Burger. It became more multidimensional, through the fine-tuning of conceptual relationships. This resulted in an on-going learning process in a real life context.

Due to the Burger's availability on the Internet, members of the audience were able to access it after various presentations, and provided presenters with on-line feedback.

The original intention of the product was the representation of a concept map. However, during the evolutionary process, the concept map acquired the additional function of an educational software evaluation tool used in practice.

The team member responsible for the HTML editing, indicated that skills gained during this construction exercise lead to her subsequent choice of "Web-based learning" as a dissertation topic. Her project formed part of an international training programme and she therefore got the opportunity to visit Germany and to collaborate with an international team of experts.

In the space of a year, the Burger became part of a collective knowledge base, when it was linked to virtual classrooms that emerged on the World Wide Web.

Other Factors in the Learning Process

Constructivist Learning. The process of concept map construction is clearly a constructivist exercise, and ties in with Merrill's (1991) reference to the development of

mental models through the organisation of memory into structures.

Aspects of REALs that were particularly prominent during the learning process are:

Collaboration. The Jigsaw cooperative learning model was followed - learners were divided into expert groups and home groups. Members of the KwaZulu Natal home group (who constructed the Burger) each belonged to a different expert group. Expert groups researched a number of topics and fed the information back to their home groups. This procedure enabled students to cover and share a vast range of information in a short space of time. Burger creators indicated unanimously that the cooperative learning process played a major role in the transfer of learning: "The initial probing and struggling for clarity and accessible metaphors facilitated a way through the more abstract, theoretical stuff and makes it easy to remember". Learners from other teams also emphasised the importance of discussions, to clarify relationships between concepts.

Generative learning. After the exchange of information took place amongst expert group team members, home-groups spent most of their time generating ideas around the reorganisation of static information into flexible knowledge structures / concept maps (Dunlap, 1996).

Anchored instruction. Anchored instruction occurs within realistic contexts that are appealing and meaningful to students (Dunlap, 1996). The KwaZulu Natal team chose the burger metaphor, as its layered structure and hierarchy of ingredients are representative of the way in which the students envisaged the relationships between various units of information (Clarke & Peté, 1997). The team felt that their choice of metaphor contributed significantly to the learning process: "The burger concept really is easy to internalise".

According to Viau (1994) metaphoric thinking has the potential to reduce the complexity of a situation "through the use of an image which clarifies, unifies, and inspires". However, a "superficial fit" will not have the desired effect on learning. These two statements are supported by the outcome of this study. Apart from the KwaZulu Natal team, one other group testified that their chosen metaphor (a mother with children) aided retention and internalisation, while other groups indicated that their metaphors were ineffective in connecting "unfamiliar situations to deep affective roots" (Viau, 1994).

Conclusion

The choice of HTML as delivery medium undoubtedly played a facilitative role in the KwaZulu Natal team's learning process. However, it is clear that other teams also recall the construction of their concept maps as valid, meaningful learning experiences, which facilitated transfer of knowledge to other situations: "The actual making of the poster enabled me to retain and transfer knowledge". The process of concept map construction involved constructivist *learning methods* such as "organisation" and "the explicit specification of relations among knowledge units" (Merrill, 1991:45). Elements of the "Rich Environment for Active Learning" within which all students learnt, are collaboration, generative learning and anchored instruction.

The main advantages of HTML as *delivery medium*, are that it is multidimensional, quick to update, and easily accessible. These characteristics have economic benefits that enable cost-effective, on-going learning processes.

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Changing Roles of Lecturers in a Resource-based, Open Learning Environment.

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In a post-apartheid South Africa, national educational policies are currently being drafted, in order to address the imbalances of the past. The Green Paper on Higher Education Transformation (1996, p. 25) outlines a comprehensive set of initiatives for the transformation of higher education. Amongst others, emphasis is placed on the use of resource-based, open learning systems:

> "...distance education and resource-based learning have a crucial role to play in meeting the challenge of greater access and enhanced quality in a context of resource constraints and a diverse student body...Distance education based on the principles of open learning leads to the development of a system which is organised for use by learners at different times, in different ways and for different purposes..."

However, according to the Green Paper resource-based, open learning is not only appropriate for distance education. It can also be used for the "reorganisation of learning and teaching in contact institutions" (1996 p. 25). Its use in this context will lead to the improvement of quality and effectiveness. Open learning seeks to increase access to opportunities by removing all unnecessary barriers to learning. Brevik (in Rakes, 1996 p. 52) defines resource-based learning as "a learning mode in which a student learns from his or her own interaction with a wide range of learning resources, rather than from classroom exposition". Both the above learning modes accommodate the reality of a diverse South African learning environment to a far greater extent than traditional means of teaching.

The Context of this Paper

The following information should provide some idea of the context of this report:

The role of the first author of this paper is educational researcher and the role of the second author is lecturer of the subject under discussion.

Institution:	Technikon Natal (a tertiary contact institution)
Qualification:	BTech Degree in Information Technology
Year:	Final year (4th)
Subject:	Operating Systems IV (OS IV)
Course Length:	Six months (full-time)
Lecturing style:	Traditional ("Chalk and Talk")
Average number of students:	10

Lecturer's Observations

During frequent meetings and discussions between the researcher and the lecturer, it was ascertained that traditional lectures pose the following problems for this particular course:

Academically Weak Students. Two out of nine students who took the course during the first semester of 1997, did not manage to hand in projects at the end of the semester. The lecturer therefore felt the need to speak to students more often on a consultative basis, in order to advise, guide, and keep a check on whether they are coping. The inflexible structures of the current system (fixed hours for lectures and fixed consultation hours of the lecturer) do not allow for sufficient communication between lecturers and senior students who have equally busy schedules.

Academically Competent Students. Senior students in the fast-growing field of information technology are often experts in a wide variety of specialist areas. Traditional lectures, where communication is one-directional, do not capitalise on the collective base of knowledge and experience that such students have. The lecturer noticed that these students often appeared to be bored during lectures. There is therefore a need for an environment where she could use the expertise of these learners in an interactive, collaborative learning environment.

Students' Observations

Unstructured Group Interview with Students. Six out of the total group of nine students who completed OS IV during 1997 attended a group interview. The students highlighted the following difficulties with their current course:

- All students held part-time jobs while studying towards their final year. They would welcome a system that had a more flexible time schedule.
- They also felt a need for access to course materials (readings and examples of software) on the network.
- By the end of the course, none of them had seen the projects completed by co-learners. They expressed the need to have easy access to these resources.
- Furthermore, access to previous years' projects could serve as a foundation upon which to build their research, in a field that rapidly expands every year.
- There was also the need for discussions during the development of projects.

Individual Structured Interview with Non-completing Student. The two students who did not hand in their projects were invited by the researcher to attend an interview. One student attended, and indicated that she experienced the following difficulties during her course:

She worked full-time at another department on campus while completing a full-time course and she found it difficult to attend the lectures.

She did not have frequent contact with other students to discuss problems while she was completing her project. She did not see their projects either during development or after completion. She therefore had the need for more frequent discussion with her lecturer and fellow students.

Interpretation of Interviews

Information from all three interviews indicate that Operating Systems IV in its existing form lacks flexibility of learning time; access to resources, and collaboration.

Strategies for Improvement

In order to improve on the current system, the lecturer and researcher designed and developed an open learning system in the form of a virtual classroom on the World Wide Web. The classroom prototype was designed during the latter half of 1997, and will be implemented during the first half of 1998.

Conventional lectures are replaced with an on-line environment that students can visit in their own time, in order to collect resources, contribute to resources and deliver assignments. The classroom serves as a "dumping site" for lecture materials and resources. A second essential characteristic of the classroom is that it will become a "construction site" as students contribute to the building of the learning environment.

An important component of the virtual classroom is a listserv (asynchronous electronic mail discussion forum) which allows students to share ideas; brainstorm problem solving techniques and consult the lecturer. Asynchronous communication was chosen in order to allow students to post questions and responses in their own time. Time will be made available for synchronous discussions during face-to-face tutorials when the need arises. This is a feasible solution, as students are mostly employed as technicians by other departments on the same campus. In this instance the purpose of open learning is not to overcome problems related to distance. It is used to improve upon the traditional, one-directional, static lecturing system, which is particularly limiting for the teaching of small groups of expert learners.

The OS IV virtual classroom is an adaptation of the University of Pretoria's Virtual Classroom for Masters in Education students (Cronjé, 1997). In this classroom the metaphor of a physical classroom was used. During a target population analysis of prospective and past OS IV students it was ascertained that the vast majority of students enjoy science fiction novels and films as well as adventure games. As a result, the metaphor chosen for the OS IV classroom is a futuristic, on-line police station named "The COP Shop" (COP being an acronym for Computer OPerating Systems). Students act as an exclusive team of technologically-minded cops and they are expected to solve distributed operating system problems, in order to rid the Internet community of cybercrime and corruption.

The structure of the classroom on the WWW is explained in the table below.

Lecturer as Facilitator and Guide. The role of the lecturer becomes more democratic as she retreats into the background to guide the learning process amongst learners, rather than to provide solutions. The facilitator of a virtual classroom for students at Master's level at the University of Pretoria comments as follows on his role as facilitator:

"a) I develop NO content. I simply point them to resources. b) I provide NO instruction. I monitor their classroom listserver discussion and prod and prompt here and there. c) I set goals and deadlines. d) I take flak from frustrated learners. e) I share their joy as they discover they can do it for themselves".(Clarke, 1997)

Lecturer as Participant. As the lecturer becomes merely another member of the listserv discussion group, she has the opportunity to learn from solutions provided by learners. In order to enable the lecturer to stay in touch with the development of discussions, it is important to encourage students to mainly make use of the listserv, rather than to send personal e-mail messages to one another.

Lecturer as Researcher. Embarking upon experimental, innovative methods of teaching also opens up opportunities for lecturers to do action research. This type of research specifically supports reflections upon small cycles of continuous experimental interventions and adjustments to improve teaching environments. Action research is collaborative and participatory (Cohen & Manion, 1992) and therefore lends itself very well to a team teaching approach.

Table 1.
Components of the COP Shop.

Briefing with Commanding Officer (Lecturer's Desk)	**Bulletin Board**
In this section the lecturer gives initial instructions to enable students to set up and test their equipment.	This link explains to learners how to subscribe and use the e-mail listserver, in order to collaborate with their lecturer and peers in solving problems.
Ammunition (Resource Cupboard)	**Training Programme (Study Guide)**
1. Subject-related Resources Students are guided towards a variety of resources concerned with the subject Operating Systems. The resources may take a variety of formats, e.g. books and journals in the Technikon library, digital libraries on the Internet, computer programmes, or URLs (Web page locations). 2. General Resources In order to effectively browse the Web, find information, and construct a website, students are given access to resources, e.g. search engines, Web editors, plug-ins (to play animation and sound files etc.) and clipart libraries.	The study guide contains 1. the topic organisation, explaining to students what the aim of the course is and what the course prerequisites are; 2. the performance outcomes, specifying the skills the students will have acquired, on completion of the course; 3. details of the unit standard (syllabus) containing the topics to be covered, as well as the duration of the course; 4. the composition of the final mark, as well as the evaluation criteria the lecturer will follow to assess all work.
Missions (Tasks)	Deadlines
1. Cooperative tasks Learners are divided into cooperative learning groups, and assigned roles, in order to contribute to the completion of communal projects. 2. Individual tasks Each learner is expected to complete an individual project.	Time frames and handing in dates of various tasks and projects are given here. The different phases of the course are specified and continuous evaluation applied, in order to ensure that students meet deadlines
Cops' Lockers (Student desks)	Team Mission Reports (Cooperative projects)
Students will post their individual assignments here. Past projects are also made available.	Cooperative tasks are deposited here.

Implications of Open Learning for Lecturers

In an open learning environment, the role of a lecturer becomes more multifaceted. In addition, there is room for participation by other professionals in the teaching and learning process.

Changing Roles
In a cooperative learning environment, the traditional role of a lecturer changes from transmitter of knowledge, to planner, manager, facilitator, guide and participant (Ryba & Anderson, 1990). Another role that can be added to the above is the role of lecturer as researcher of the learning process.

The Lecturer as Planner and Manager. One important aspect of this role is to organise access to adequate resources.

Table 2. Computer resources required per individual OS IV student

Hardware	Software	Network
Windows workstation	Web browser	Email account
	Web editor	Internet link
	Graphics editor	Storage space
	EMail software	on network

In addition, shared resources include printers and scanners.

Sharing the Load with Other Professionals

Educationalists other than the lecturer accepted the invitation to participate in the teaching of the new OS IV course. For clarification, the team members are divided into the following four categories: virtual classroom facilitator/manager (previously lecturer); learner; educational researcher; librarian.

The role of librarian becomes particularly important in the context of resource-based learning through the medium of the Internet. The World Wide Web (WWW) as a resource base in education has to be used with an awareness of the following:

It is easy to waste vast amounts of time while wandering aimlessly through this unstructured, multidimensional environment.

Information tends to be updated, improved, rearranged, and moved frequently (Rakes, 1996).

In collaboration with lecturers, librarians can participate in the evaluation of WWW resources, as well as in teaching students how to evaluate sources for their appropriateness, before they are used.

Implications for the Curriculum

The National Qualifications Framework

In the process of educational transformation, a National Qualifications Framework (NQF) was recently established in South Africa. One of the principles on which the NQF is based, is portability, which will enable learners to transfer credit across different modes of study and qualifications within the national framework: "The Framework will prevent learners from being locked into one learning compartment or another, as happened in the fragmented system." (Human Sciences Research Council, 1995 p. 6).

The NQF defines a "unit standard" as the smallest unit that can be meaningfully assessed, previously known as a "subject" within a qualification. The curriculum development process of Operating Systems IV is done according to the necessary requirements, so that it can be registered as a unit standard with the NQF.

Performance Outcomes of OS IV

The value of the development of the OS IV virtual classroom lies in the fact that it contains a model that can be used by other teachers who wish to experiment with resource-based, open learning. In this regard, the unit contains: performance outcomes related to *study skills* (amongst others, information literacy); performance outcomes related to *computer literacy*, and performance outcomes related to *Internet literacy*. These outcomes can all be adapted and used by other lecturers. Lastly, performance outcomes related to the specific subject area (e.g. OS IV) will differ for every subject.

Conclusion

The implications of the new structure of OS IV are :

- a more flexible time schedule, to accommodate senior students;
- increased access to resources;
- opportunities for better communication and collaboration;
- a richer and more challenging role for the lecturer of the course; and
- a more flexible curriculum that fits in with NQF requirements and standards.

The course in its new form should therefore make a constructive contribution to higher education transformation in South Africa.

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Sharing and Building upon International Teacher Education Experiences

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This paper describes the Texas Southern University/University of Dar es Salaam (Tanzania) Fulbright-Hayes Group Project that culminated in the summer of 1997 with a five-week in-county study tour. A team of 12 educators from Texas Southern University and Houston area schools studied the history and culture of Tanzania with a focus on education and the social service system of the country. The Fulbright group visited schools, social service agencies, teacher training colleges, the Open University of Tanzania and many other places of interest in Tanzania and Zanzibar. Moreover, the team interacted with scores of educators and other Tanzanians.

A major intent of the Tanzania based explorations and study was to create an authentic framework from which educators would design resources for use in US classrooms. Project planners recognized that a field experience in Tanzania would both update and invigorate instruction on Africa. Further, teachers are more likely to use resources frequently and to promote their use among colleagues when they are confident that the information is both accurate and current.

The Fulbright Project focus on authenticity parallels this emphasis in educator preparation programs in Texas. A major indicator of authenticity is the field-based, real-world orientation of the new educator preparation programs. Creating teacher preparation programs that more accurately mirror the tasks of teaching will ensure the development of more effective first-year teachers.

In preparation for the study tour, participants were engaged in several weeks of inservice that focused on basic protocol, beginning language instruction in Swahili, and the history and culture of Tanzania. Project Director, Dr. Gregory Maddox, a professor of History at Texas Southern University, conducted the major pre-country inservice. Dr. Zuberi Mwamba, a Tanzanian and a professor in Public Affairs at Texas Southern University, was a Project consultant, as well as a participant. Another consultant to the Project was Tanzanian historian Dr. A. B. Itandala, a former Fulbright Scholar at Wartburg College in Iowa. Moreover, Internet resources were utilized to gain the most up-to-date information. During the pre-country preparation, Fulbright participants had an opportunity to choose the focus of their research in Tanzania. A broad range of study areas was selected since the makeup of the team included educators from the public schools as well as the university.

Goals of the Project

Broaden the Multicultural Component

The first goal of the project was to broaden the multicultural area studies portion of the academic foundation courses at Texas Southern University. These courses are comprised of a designated sixty hours of baseline courses in the College of Arts and Sciences. Integrating the content into courses that all students take is a way to expand students' knowledge base about the peoples of Africa and expand their cultural world.

A related intent is to increase student interest in international careers by dispelling some of the misconceptions about the peoples of Africa. By building the information into the content of required university courses, the faculty can pique students' interest in international study. Texas Southern University Fulbright participants represented the faculties of art, education, history, public affairs, political science, sociology and social work. Their preliminary curriculum integration efforts are already enriching the courses they teach.

Still another intent is to improve the quality of cross-cultural communication among students at Texas Southern University. The enrollment includes students from most states and more than 60 countries around the world. Sometimes most US students have not had sufficient international travel opportunities to hone these essential cross-cultural skills. Potentially, the infusion of African content will stimulate new dialogue between US students and those from the international community, resulting in enhanced communication among diverse cultural groups of the US as well.

Strengthen the Cross-Cultural

The second goal of the project was to strengthen the cross-cultural strand in the teacher preparation program. At the undergraduate level a new multicultural course is based on three strands–exceptionality, English language learners, and the relationship of culture and learning. Each of these components will extend prospective teachers' understanding of learners and what variables enhance and inhibit student success. The exceptionality strand will emphasize learning styles, the principle of giftedness, and the assessment of those gifts through multiple-intelligence inventories. The English language learners strand is comprised of research-based teaching strategies that support the success of students whose first language is other than English. The culture and learning strand will be enhanced by the integration of content that identifies the cultural variables that support learning. The study data on urban schools in Dar es Salaam, a large sprawling metropolitan area, will be useful for comparatively discussing issues associated with urban schools.

One area of concern in urban schools is interaction among ethnic and cultural groups, both among teachers and students. Prospective teachers are expected to support the success of students from all learner groups without regard to ethnicity, gender and income. The teacher preparation program designers at TSU are committed to reducing bias and building intercultural competence among prospective teachers. These are essential for teachers who will be equipped to support success among a broad cross section of urban learners.

Strengthen the Multicultural Education Component

The third goal of the project was to strengthen the multicultural education component of the curriculum in Houston area schools. One elementary teacher, one middle-school teacher and two high school teachers participated in the project. One early effort resulted in the collection of 400 books that were shipped to a partner school in Dar es Salaam. A middle school teacher who was among the Fulbright scholars initiated this project. The involvement of Houston area teachers has created a cadre of resource persons for the surrounding school districts. This hands-on, in-country study opportunity was created to ensure that teaching resources would be current and would have an authentic perspective.

Dissemination of the Information

These resources are being disseminated in several ways. Some resources are being shared as PowerPoint presentations in conference settings, community meetings, school-based inservice programs and university classes. Other resources are being shared through the World Wide Web, as well as email and listservs. Links were established between Houston and Tanzanian educators that will lead to joint publications, conference presentations, and research, in addition to other kinds of partnerships between students from various places.

A 1998 special issue of the *TSU Research Journal* will feature papers developed by participants of the TSU Fulbright Project and selected faculty from the University of Dar es Salaam in Tanzania. Some of the invited papers will emphasize the history and culture of Tanzania, the framework for the world-class lectures at the University of Dar es Salaam, during the opening days of the Fulbright study tour. These lectures gave insightful interpretation to information that we had read about Tanzania.

Efforts are also under way to establish a pen pal project that involves students in school-to-school interaction and club-to-club interaction in K-12 settings as well as the university level. Some elementary school projects are already up and running. On the university level, teacher education students at the Forodhani Secondary School are beginning a communication project with teacher preparation students in special education at Texas Southern University. Currently in Tanzania, individual student access to email is limited. Potentially, this project will broaden to include more teacher preparation students at TSU in other disciplines during subsequent semesters.

Other efforts to disseminate information include the development of educational resources on the web. On the Texas Southern University College of Education web site (http://www.coe.tsu.edu/faculty/ligons), there are travel logs, recent in-country photographs, the trip itinerary, lessons and workshops. These resources provide an accurate and detailed description to students, teachers, university faculty, and government officials associated with the Fulbright Program. The portability and instant access of these resources will ensure their usefulness to educators at all levels. These teacher-made resources on the TSU web site provide links to related web sites. These links will be updated and enlarged as collaborative efforts produce additional lessons, thematic units, contemporary photographs and other resources. The main goal will be to provide authentic, virtual experiences to students of all ages as they are preparing to interact in a global community and interact with people of various ethnic groups. These resources are intended to shape the development of more accurate perceptions about culturally different others and build mutual appreciation will develop in students of all ages.

Dissemination of information will also be accomplished as participants conduct workshops and make presentations in university settings, local schools, and Houston area communities. Recently, the authors shared the above resources with upper elementary students at the Texas Southern University/Houston Independent School District (TSU/HISD) Lab School (See Figure 1.). The receptiveness and curiosity of the students and faculty

validated the need for such interactions. This information was also shared at the fall 1997 conference "Research and the Production of Knowledge in Africa" which was sponsored jointly by the Center for the Study of Culture at Rice University and the Mickey Leland Center on World Hunger and Peace Studies at Texas Southern University.

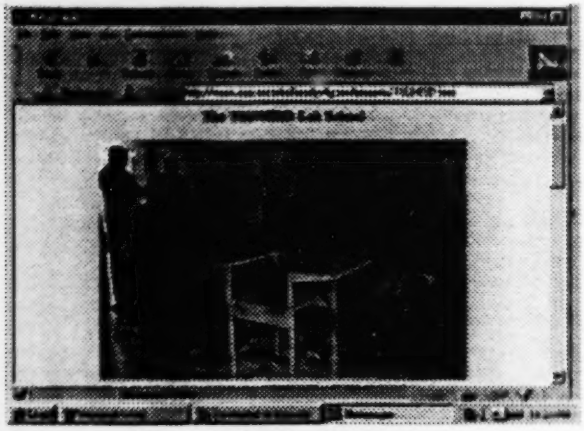

Figure 1. Sharing Resources.

Community efforts include sessions for Transformations, a program at Wheeler Ave. Baptist Church. Transformations is a mentorship program for pre-teenage girls that provides a variety of enrichment experiences while dealing with some of the contemporary issues of adolescence. The pairing of each girl with an adult mentor is a special feature of the yearlong program. Fulbright participants created hands-on experiences and provided information to expand students' views of the people of Tanzania and their customs.

Conclusion

The five-week study tour was a rewarding professional development experience for all of the Fulbright participants. It was 'real world' since the experiences occurred in Tanzania. As participants teach the content they can present it in more authentic ways as a result of their study tour. Moreover, their positive experiences will influence use of the resources among colleagues at all levels of education.

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Cooperative and Contributive Learning in Professional Education

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An important role in the Open Information Society (as knowledge based society) will belong to general education, professional education, and training. A knowledge-based economy demands greater openness and creativity in schools and universities. Citizens will need to acquire new skills and adaptability through life-long training. An open approach to education that combines local and national cultures and promotes mutual understanding between all people is required.

The development of the Internet and Global Information Infrastructure (GII) development in the world changes the main paradigms in education and research. This development requires new skills if humankind is to survive the Information Revolution and start building the Information Society (also defined as the Post-technological Society). The main driving forces are shifting from a focus on technologies that are rapidly changing, to a focus on knowledge, together with learning acquisition.

Education should respond to the global challenges of forming the Information Society by providing the necessary foundation for people to be successful living in this new knowledge based formation. This is includes:

- forming base knowledge and the motivation for a constant improvement of knowledge and skills,
- setting up of life-long learning goals, and
- establishing free access for learning and training materials.

This paper describes two years experience and the results of the development and implementation of a new instructional methodology for teaching Internet/ Intranet Networking and Information Technologies, this in conditions of emerging new technologies and rapidly developing Internet infrastructure in the Ukraine. The development and implementation of a new educational approach that combines cooperative and contributive learning models has allowed the organization educational processes in the real conditions of restructuring economy with limited state support for the implementation of new technologies.

Principles of Teaching in Networked Information Environment

The proposed instructional methodology is very similar to the Project Based Learning (PBL) in that it signifies the advent of the new educational paradigm in a knowledge based Information Society. In this new environment, students and teacher become collectors and produces of knowledge/information, contrary to their previous respective roles of being just receivers and the source of information in the old models of education prevalent in industrial and technological societies. The main issues of such new approaches belongs to the search, transfer, and acquisition of information and knowledge in an information and knowledge rich environment formed by GII and Internet. These are not limited by classroom and national boundaries. Students in such environment are capable not only of consuming information and knowledge but also of introducing new information and even skills retrieved from the Net.

The main principles of teaching modern information technologies in technical, technological, and non-technical education can be formulated in the following ways:

Learning from the Internet – Contributing to the Internet. The new paradigm of education in a modern networked information environment should be incorporated into the development of instructional methodology.

Cooperative Learning Model + Students' Initiative. Using Internet/ Intranet technologies teachers and learners can mutually benefit from the implementation and mastering of new technologies. A key role in exploring this principle belongs to educational projects and relies on a cooperative model of course management that effectively uses students' initiative in mastering new technologies.

Contributive Learning Model. With students' wide use of computers and multimedia technologies and the rapid technology changes, teachers can not always have a strong base in practical technological experience in every piece of hardware and software. In these circumstances they should play the role of mentors and/or managers of the educational process or curricula. Teacher can propose

some idea of *contributive learning* project where students or student groups work on projects that will really be implemented in the building of the campus computer network, the development of information resources, or meeting some other societal technological need.

Integration of Traditional and Distance Learning. The new networking environment provided by the Internet/ Intranet eliminates differences between traditional and distance learning, while stressing interactive on-line (IRC, conferencing) and off-line (e-mail, mailing lists) communication among teachers and students.

Concept of "Active Position". Complete implementation and full benefits from using Internet and new information technologies in education can be achieved only by using this principle, one that is very close to the idea of contributional learning. It is not enough to give students and teachers Internet access. To use Internet, effectively faculties should start development of their own Internet resources and creation of their own Internet presentations.

Piloting New Instructional Methodology

A pilot project on the development of an educational program and instructional methodology for teaching computer networking and Internet information technologies has been started at the Computer Aided Design (CAD) Department at Kiev Polytechnic Institute. Two groups of 50 fifth year engineer students began work on their advanced degrees in September 1995 and 1996. Seventeen students of the first group successfully defended their Master theses in June 1997. All students were involved in the development of the technical and information base for a complete educational course.

The pilot educational program includes these main specialized courses on computer networks and networking information technologies and services:

- Computer Networks Basics, LAN, and WAN Technologies
- Internetworking and Network Management
- Internet/Intranet Information Technologies and Services
- Advanced Networking Information Technologies (Security, Java, VRML, Internet Publishing, etc.)
- Internet Business Applications and Information Technologies Business Process Re-Engineering
- Information Society and Advanced Communication Technologies: Social and Cultural Impact

Due to the rapid development of modern networking technologies more than 40% of the course content had to be changed during the second year as well as significant changes in the themes of educational projects. Information about new technologies and standards were directly transferred to students by lectures, classes, and via the departmental server.

All courses are supplied by instructional and computer presentation materials that are distributed among students in paper and/or electronic form. Some materials are available on an educational WWW server (*http://cad.ntu-kpi.kiev.ua/*). This allowed for the creation of an initial base of instructional and educational materials as well as to adoption and testing of Russian/Ukrainian terminology in real lecturing and educational project development. Some practical experience is acquired by students during the design of real educational network projects for real academic and educational institutions. This includes development of necessary information services for the operational needs of the organization and/or users' group. Also practical installation of services and pilot information resource development is performed in a special educational laboratory.

Two main components of complex educational projects are: (1)network infrastructure design and information server structure and (2)content development.

Projects are developed by groups of three or four students and include all necessary components of a real networking project design for campus or a company's network. This includes organisation for the optimal cooperative work of the project group.

During the design period all projects have their homepages on the educational WWW server at CAD Department in special working directories (see reference page at *http://cad.ntu-kpi.kiev.ua/academic/projects/webprj96.html*). After completion and final editing by webmasters the Web pages or templates are moved to their final location on departmental WWW Server or to other designated servers. Original works are left in their working directories for future use as templates by other students.

The contributive part of these educational projects resulted in development of the information content of an experimental server *"U'Pavilion - WWW Server on Historical and Cultural Heritage of Ukraine"* (*http:/ www.park.kiev.ua/*).

Summary

Supporting the successful realisation of the new educational program complete with new instructional methodology is the idea of *cooperative and contributive learning* enforced by6 both *students' enthusiasm* and the wide interest of professional and business circles in Ukraine.

Replication of the described experience is very simple to implement but demands an experienced and devoted teacher corps capable of "playing coach". Some areas for fruitful international cooperation should be found in the development of distance education on the base of these results and existing technologies. These would provide the basis for better utilisation of developed educational courses and instructional methodologies on a wide variety of subjects for Universities.

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Information Technology in France: New Trends and Perspectives

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In France, as in many industrialized countries, no one can ignore that a new technological wave is coming and that it moves relatively fast. The market of personal multimedia computers is soaring and more and more software can be bought in department stores. Only a minority of homes have an access to the Internet so far. But the topic is quite popular and newspapers publish a lot of articles about it. Some of them consider it as essentially opposed to the classical culture (because it promotes zapping) and hence express doubts about the possibilities it might have any kind of virtue in an educational context. But, on the whole, authors are generally favorable, and sometimes very optimistic indeed.

Once again, there is a public debate with some ambiguity. For example, an amalgam can be noticed between then Internet as a communication system (allowing e-mail forums, etc.) and multimedia software. This is not surprising since this new rise of information technology offers learners new resources to solve problems in quasi-autonomy, whether they are on-line or off-line.

In schools, the new wave is also flowing: multimedia software become available; the number of connected schools increases, giving rise to interesting innovations: research over the Web shows a blossoming of school-based WEB sites, often supported by local and regional academic authorities.

But Internet and multimedia software come in after other technologies (television in the fifties and the sixties, computers in the seventies and the eighties). For these technologies, many innovative, often brilliant enterprises led by teachers with strong commitments have been reported. But most of them have not converted themselves into large scale everyday classroom practices.

The analysis of the French situation shows a great heterogeneity: between subject matters, between school levels and even between schools. Moreover, models of integration are not the same depending on the kind of usage: presentation of information, production of documents, software instruments for subject matters, educational technology (Baron & Bruillard, 1996, Baron, Bruillard, & Chaptal, 1997).

Concerning educational technology, the situation is similar to the one described by authors like Larry Cuban, with cycles of hopes and disenchantment (Cuban, 1993), suggesting that it's wise to adopt a position of "cautious optimism". Regarding software instruments, progressive stepwise integration can be recognized on the long term, notably in scientific and technological subjects (Baron & Bruilllard, 1994).

In fact, if many people seem convinced of the necessity of using IT in schools and if integration is a key word for all levels and all fields, there is no real consensus about what this really means and about what is really expected from teachers. In colleges of education (IUFM), things are changing slowly, too. When beginning their professional training, most students are willing to learn about IT as a set of professional tools. But only a few of them really can (Baron & Bruillard, 1995).

Overall, integration is a slow process whose end cannot be forecast. There are critical moments when innovations either move forward in development or are abandoned, depending on the support they receive from different interest groups.

Particularly in France, the national level traditionally plays an important part. All the pedagogical issues are under its control; the curriculum is nationally defined and teachers are civil servants appointed by the State. The country is still rather centralized, even if important changes have occurred in the last dozen years, all focusing on local initiative: since 1989, schools must prepare a pedagogical project and receive funds from the local authorities (notably for buying hardware).

A New Impulsion

Politicians have been aware for several years that Multimedia and networks were something important, not only for industry and business. Several official reports have been published since 1994; every one of them has considered issues regarding education and advocated measures to help developing information and communication in

schools. In the fall of 1997, the minister in charge of education and research announced a global plan for the next three years. This plan, with an announced budget of several billions US dollars, aims at several objectives.

Promoting a New Global Educational Approach

In this new plan, the computer is presented as allowing students to have a more active approach to learning; the diversity of media is expected to stimulate their creativity and to promote personal work. What is looked for is a real integration in educational actions. This is recognized as difficult task relying both on each teacher's ability to innovate and on the adaptation of software to new pedagogical aims.

Creating a New Network

The creation of a new "decentralized network" (called EducNet) has been announced, based on a partnership between teachers, regional authorities, and the national state. New ideas appear, as the recognition of a coordinator in every school, in charge of helping and promoting the diffusion of new practice. Partnership between schools and enterprises (notably in the telecommunication field) is looked for, in order to limit the fees of access to the Internet (in France, local telephone calls are not free). Last but not least, an emergency plan has been announced for the IUFM, providing for the creation of postdoctoral grants for young Ph. D. students.

Producing and Spreading Pedagogical Contents

A new policy of support to the industry for multimedia has been announced. The utmost importance of teacher initiative is recognized and support is to be given to those who would want to create their own enterprise. In the same time, the department of education is considering how IT could be introduced in the curricula.

Concretely, three priorities have been defined for the next three years:

- Each student, from pre-elementary school to university should have the opportunity to perform learning activities with information technology (manipulation and drawing in kindergarten, electronic mail for grade 2, Web access for grade 4, network activities for grade 6_).
- Each teacher, each class, each university student should have an Internet address by the year 2000.
- All the information needed by teachers should be accessible by a digitized network.

In the field of technologies in education, government support is always welcome and this new public policy will certainly help innovators going forward to invent new ways for improving learning in a classroom setting. The problem, however, is to know what are the new trends and perspectives.

New Trends

In the field of IT, the last national plan was called "informatics for all". Launched in 1985 by the prime minister, it aimed at promoting IT in every school, by equipping them with "nano-networks", based on home computers made by the national enterprise THOMPSON. Workshops were to be open to the public, helping disseminating knowledge about computer tools. It also had a telecommunication component, since it foresaw the development of electronic communications, following the national standard of the MINITEL (a kind of Network computer very popular in French homes).

This ambitious plan has given rise to many debates. It has certainly lacked protracted political support and has known severe difficulties after a first initial enthusiasm. Its initial objectives have certainly not all be reached. It is rather common in France to consider it as a failure (but this is often the fate of any previous politically driven operation), but research has shown that it has had a profound influence (Baron & Bruillard, 1996).

Of course, it is impossible to compare it with the newly announced plan. However, it is possible to compare initial intentions and to try reanticipating developments. The current plan, which explains the rationale both in pedagogical and political terms, has several original aspects.

New Partnerships

First, regarding hardware, their quick obsolescence is taken into consideration; hence, schools are not to purchase computers, but to hire them. Creating cooperatively new pedagogic services is at the core of the plan. Explicit emphasis is put on partnership (between schools, the different academic authorities, and enterprises), the federation of energies is very explicitly wished.

Secondly, the plan insists on the development of new resources for learning and recognizes a prominent role of teachers, notably in the field of software development. This rather new idea contrasts with the previous general opinion. It also explicitly provides for the appointment of special "resource persons" in the schools, whose task will be to disseminate knowledge about good educational uses of technologies.

One Key Issue, Teacher Education and Professional Development

The plan pays great attention to teacher training. This point is not wholly new, since France is certainly one of the countries where the investments in teacher training (mostly inservice) have been very important. But preservice training is now clearly identified as a crucial issue, which is coherent with another reform aiming at relating more closely inservice training to preservice education and giving more responsibilities to IUFM. More generally, the education of the different officers in charge

of education is considered a priority, which certainly corresponds to real needs.

Perspectives

Once again, something new is happening. We are in a foundation-building period, with an initial accumulation of expertise (much is expected of teachers' individual initiatives), but zones of uncertainty. IT is seen as a transversal tool and the general recommendations about what teachers have to do in the subject matter they teach are not really precise. There is no requirement about the nature of classroom activities.

Several problems have to be solved. The success of the plan depends on changes in the way teachers teach: for example, collective work is advocated. But creating a new professional culture is not an easy task. Two issues at last remain problematic: the evolution of classical subject matter in schools and changes in assessment. How, for example, can new technologies be integrated if students do not have the opportunity to use them during examinations? It is plausible that much time will pass before new practices emerge.

However, as we have seen, the emphasis of the new plan is on communication. The Internet, because it allows direct communication between peers, might prove a good support to disseminate and capitalize on innovative practices led in school with IT, what many call success stories: The possibility to transfer experiments to other context nevertheless remains an issue.

Teacher education is obviously very important. But which kind of education? Nowadays, many preservice teachers have a personal familiarity with word processing and, more generally, with software for producing documents, even if their approach is more than often rather naive. With time, their technical competencies can be improved, without dramatic changes in the organization of studies at the IUFM. But technical competencies are not enough and it is quite certain that having a personal acquaintance with software is insufficient to guarantee professional use.

The appointment of young postdoctoral students in IUFM is in this respect an interesting idea, especially if they can help trainees understand the role now played by IT in their subject matters. However, as has been remarked many times, a key issue is that trainees have hands-on experience with IT during their practicum, and, therefore, that their mentors be familiar with it.

One of the reasons why using IT in the classroom is not an easy task, specially for young teachers, is that there are no validated models of teaching with technologies compatible with the current constructivist views of learning. This makes difficult identifying the necessary competencies that should be developed among new teachers. An important issue therefore, tied to educational technology, is to elaborate, implement and validate such models.

This poses of course, once again the problem of producing software. Many earlier works have addressed the issue of authoring languages, allowing ordinary teachers to design courseware. Now, conditions have changed. The design of multimedia software is, on the one hand, a growing industry, where developments are done by teams and where markets have an international dimension (with, however, serious problems of adaptation to different cultures). On the other hand, it would be suitable to have easy-to-operate software, allowing teachers to design disposable micro environments, adapted to their particular needs at a given moment.

Thus, many questions are open. A governmental plan gives an important impulse. Many initiatives will take place; many persons will be involved; projects will be planned; and schools will be provided with hardware and Internet access. But it is just a beginning, a new start. New problems are certainly to be solved. Research (notably comparative research) has ideas to provide and a part to play.

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Design to Instruct: Lessons for Training through Involving Teachers in Design

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The meeting of multimedia and telecommunications promises an explosion of new computer-based applications for education. Only a few years ago it was assumed that packet-switched networks, such as the Internet, could not be used to transmit real-time audio and video because of the delays inherent in shared networks. However, improved compression techniques and the advent of multicast in the 1990s have changed this. (Multicast is an efficient way of routing traffic over networks that makes multi-way conferences possible at readonable cost and without causing undue network congestion. See Macedonia & Brutzman, 1994) It is now possible to take part in real-time, multiparty videoconferences, from a desktop computer. Educational institutions at all levels are connecting to computer networks and the potential to enrich student learning is huge. Yet, whilst university research staff hold "live" project meetings with partners all over the world, or watch lectures transmitted from conferences they cannot attend, teaching staff are only beginning to explore the possibilities of this new technology.

Barriers to the acceptance and use of computer-based technology in schools and colleges are well documented. There may well be resistance to change amongst both management and teachers but underlying this are a number of other factors. Williams (1994) describes vividly the pressures on teachers and institutions that limit access to training. Bates (1995), however, suggests that the greatest obstacle is the unfamiliarity of the technology, which erodes teachers' confidence. He too points to inadequate training as the key underlying cause. He states that the problem is not simply ignorance about how to use a piece of technology but, more importantly, the "lack of an appropriate conceptual framework to guide the use." This problem is particularly acute in the Higher Education sector, where few of those who teach have a foundation in educational theory or instructional design. He warns that, without such a framework, people will fall back on the methods that were used to teach them – a strategy wholly inadequate where social and technological changes are rapid.

To make effective use of information technology, teachers must learn more than just how to make the system function; they need to use it to communicate with their students and to deliver appropriate and effective courses over a period of time. Whatever conflicting theories exist about teacher training, it is generally accepted that those who deliver it will be able to draw upon extensive practical experience within a rigorous theoretical framework. It would therefore seem reasonable that teachers should be introduced to new technology by experts from their own domain, rather than by experts from the technology domain who might be seen to have different objectives and not to understand what teachers and students need. At present, however, not enough teachers have the relevant technical knowledge and even fewer know how to combine it with appropriate practical experience. In the case of very new technologies the shortage is even more acute and the content of a training programme may be hard to determine.

The work presented arises from research into the design of real-time multimedia systems for education. Approaches derived from the participatory design movement (see next section) have enabled teachers to play an important part in developing a language tutoring system. The paper discusses the techniques used and considers the implications of the work for staff development and training. The aim was to make the technology acceptable to teachers and to empower them to shape it to their needs.

The Technology and the Teaching

A joint project was established between University College London(UCL) and the University of Exeter, forming a partnership between computer scientists and teachers to investigate the feasibility and implications of teaching foreign languages over computer networks (See Hughes & Sasse, 1997).The project, Remote Language Teaching over SuperJanet (ReLaTe), is a real-time system for small-group distance language learning, incorporating audio, video and a shared workspace. It uses ordinary

computer workstations and runs over the multicast backbone of the Internet. Separate tools for each medium (audio, video, and shared workspace) are combined into a single window (see Figure 1). This interface was designed for small group tutoring but it could be configured for larger groups.

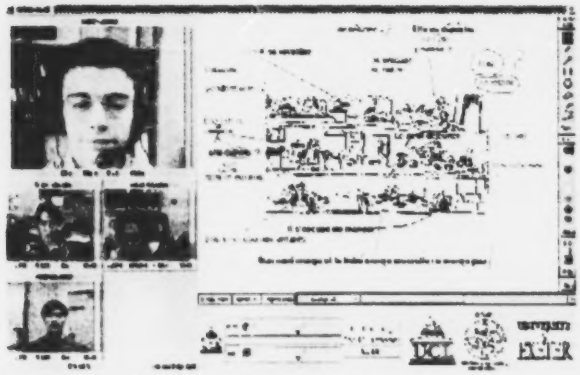

Figure 1.

On the left is the video area, where four images can be displayed with a choice of size. Participants select the image to be displayed in the larger rectangle by clicking on the name bar above it. The shared whiteboard on the right allows displayed text and graphics to be seen and annotated by all, and all may write or draw on it simultaneously. Users can replace this with a shared text editor by pressing a button. The audio controls allow users to adjust incoming and outgoing volume.

The prototype system has been used in 10 and 22-week field trials, with language learners at levels from beginner to advanced. Five courses were run, in three different languages. In all of them, the tutor and students were geographically dispersed, sitting at individual computers at various locations in London and Exeter, connected via the UK academic network. Five tutors and twelve students participated.

Why use a PD Approach?

Participatory design (PD) originated in Scandinavia as part of the workplace democracy movement (Clement & Van den Besselaar, 1993) but the term now covers a continuum of user-centred design approaches. Carmel, Whittaker, and George (1993) give an indication of the range. Participatory design was used here for a number of reasons. First, Grudin (1991) has stated that a participatory approach suites novel, interactive applications. Secondly, participatory methods have traditionally been used for custom-built systems and this is exactly what was required in this instance. There was no existing blueprint and the application being designed was very specific. A PD approach also suited the work situation because teaching and learning can not be described adequately in terms of data flow and task analysis, favourite designers' tools. Another factor was the participatory design view that changes in work practice should run alongside the development of computer systems. This fitted the philosophy of the project. PD also tackles cross-domain communication problems, certainly relevant in this project, where computer scientists and language teachers would be working together. The PD view is that development is cooperative, learning a two-way process, rather than one where "expert" technologists transfer information to "inexpert" users. Finally, PD evolved to combat the idea that technology was a threat to the worker, instead regarding its introduction as a way to improve the quality of people's working lives.

PD Principles and Practices

Participatory design does not follow a rigid formula. Instead, researchers have developed a repertoire of tools and techniques to promote equal participation of users in design. Whatever techniques are used, a few broad principles underpin most work. Apart from those mentioned above, practitioners believe that concrete experience is needed to inform abstractions (so developers must gain workplace experience and users experience with the proposed system) and that requirements will not be understood fully until users have worked with a system for an extended period.

Muller, Wilman, and White (1993) present a taxonomy of PD techniques. Wall and Mosher (1994) and Kensing and Munk-Madsen (1993) also provide reviews of methods. Those most commonly used are unstructured interviews, formal and informal group discussions, future workshops, graphical techniques to aid both visualisation of the future system and representation of the workplace, and prototyping. Prototyping is a particularly important tool and includes everything from storyboards, through HyperCard-based simulations to working systems. Often low-tech artifacts, such as plastic tokens or post-it notes (Muller 1991) are used, in order to diminish the intimidating effects of unfamiliar technology. Observation of the workplace and of prototype systems in use is essential. Extensive records are kept, including audio and videotapes, notebooks and illustrations. These may form the basis of further discussion and in certain cases may be reused in future projects.

Methods Used in the Project

Central to this project was the creation of a fully functional prototype, and its use in field trials. The working demonstrator system described above was constructed and used in trials over a period of nearly two years. Because there are separate tools for audio, video, and shared workspace and these are configurable, it is possible to construct conferencing systems to support a range of different applications. (In this case the tools used were *vic* [Jacobson, 1994], *rat* [Hardman et al 1995], *wb* [Jacobson 1993] and *nte* [Handley 1996]. The references

are to technical papers.) In effect, the team had access to an immensely flexible rapid prototyping tool. Not only the appearance of the interface can be configured, but also modes of communication (An example,in our configuration, is the choice of full duplex audio rather than the default push-to-talk mode. See Watson and Sasse (1996) UCL) New elements can also be attached as required. The process has been cyclical, with the activities described below feeding into development of the system, which in turn led to further associated activity.

Observation was a key part of the process. Teachers were observed both using the system and in the classroom, by developers and education experts. Results were recorded digitally and on paper and formed the basis for discussion and written reports. At key times, questionnaires and rating scales were administered, and unstructured interviews were conducted with students, tutors and other language teachers outside the project. A variety of group activities were constructed, using focus groups to draw out participants' opinions and experiences, and workshops to encourage thinking about future developments. The composition of groups was varied (with teachers and students sometimes together and sometimes apart). Digital recordings of lessons were made using a conference recorder developed at UCL. This has proved to be a non-intrusive way of obtaining a full record and has produced a huge amount of data, the use of which is discussed in the next section. Alongside this, written and spoken comments from teachers and students have been analysed with a view to determining which terminology and concepts cause difficulty and to evolving a shared vocabulary for discussing certain aspects of the system, particularly audio and video quality.

Results

As reported by Watson and Sasse (1996) and Hughes and Sasse (1997), the efforts to involve users in design have resulted in a system that is fun and easy to use. The highly interactive tutorials were agreed to be rewarding, intense and involving. Language teacher assessors particularly applauded the fact that reading, writing, listening, and speaking skills were developed together. Although the system was designed for teaching foreign languages, the lessons for teacher development are probably applicable to other subjects.

Uncertainties of Networks

Teachers have gained a greater understanding about the nature of networked systems and, in particular, appreciate the uncertainties involved and have learned to plan for them. Conditions in shared networks can fluctuate rapidly. Congestion may cause sudden changes in video or audio quality that can be alarming but are usually transitory. Once teachers experience this a few times, they learn to plan for a change in activity in the same way that they are flexible in a classroom. Training can prepare them for this.

Another disconcerting factor is that in such systems some things can not be known for certain. Failure to reply to a question, for example, can be the result of local equipment failure, software failure, a problem with a link in the network or simply the fact that someone has taken off a headset or muted a microphone. Teachers gradually learned how to eliminate the most obvious causes but the problems this can cause should still not be underestimated.

New Ways to Communicate

Superficially, a lesson over the ReLaTe system is similar to one in a classroom, but computer-mediated communication, even with the aid of audio and video, differs from face-to-face communication. Teachers found it harder to sense the group atmosphere or to detect when the class needed a change of activity. They did, however, feel they could still sense an individual student's personality, and they talked of their students in the same ways as do face-to-face teachers. During lessons, more overt signaling was needed. Teachers could not use eye contact to indicate which student was to speak and, similarly, students could not convey by body language that they would rather not be asked a particular question. Remembering that others could see only what was within the camera's field of vision also had to be learned; words were needed to explain actions that would be obvious in a face-to-face situation. The interplay between communications channels (the whiteboard, audio and video) was also slightly different from that between the face-to-face equivalents.

Managing a New Environment

Teachers developed experience and greater understanding about managing this unfamiliar working environment. They were constrained physically by the equipment and cut off from external stimulus by headsets. This made it harder to retain a sense of time and to pace a lesson. The trials also raised questions about the boundary between technician and teacher. To have full control over resources, the tutor must understand a computer file system and the formats in which material can be stored. Finally, the physical environment must be managed, so that there is sufficient space for equipment and the lighting enables people to see one another but is not uncomfortably hot or bright.

Preparing Teaching Materials

It is easy to assume teachers know already how to choose material and devise activities around it. Here, as elsewhere, some lessons had to be unlearned. For example, incorrect assumptions were sometimes made about translating from classroom to system domain. Although the shared workspace usually performed the function of a photocopied worksheet, there were times when the camera was a better means of showing things to students. Similarly, the camera was not always an adequate substitute for

holding an object up for the class to see. Material may have to be altered in order to display it effectively on a computer screen and if teachers are not to be over-reliant on technical support they must learn to use machines, such as a scanner.

Adding New Elements

As in most courses, a varied mode of delivery was needed. Teachers began to explore ways of integrating this real-time communication with e-mail and the World Wide Web. Having to learn more new applications was a burden, however, and this was a good example of the extra cognitive load imposed on both tutors and students by the use of multiple software applications.

Training Materials

Because these lessons were observed and discussed so fully there is now a large store of materials, including recordings of lessons, images of whiteboard and text editor screens, audio recordings, observers' notes and reports. These have already proved an effective stimulus to discussion but they could also be used in training. It is hard to give teachers the time to watch their colleagues at work. Recordings offer them the chance to observe lessons in their own time. It is also possible to interact with the recordings, adding commentary or questions, and to transmit them to remote locations. Trainees need not all be on one site.

Terminology and Concepts

There was an evident gulf between teachers and developers here. It also proved to be important. Language is so closely linked with thought that one cannot assume teachers do not need to know any technical terms. The teachers found it difficult to discuss aspects of audio and video quality and to understand the factors that affected these. This made it harder for them to explain what changes were needed and had implications for their use of the system, especially understanding its limitations. It also made some functionality inaccessible to them. The interface was specifically designed to hide complexity but some of the hidden, more advanced features are useful. Unfortunately, they are labeled in technical terms. It is in this area that the meeting between designers and users is so crucial; the implications for interface design are as important as those for training.

Conclusions

As suggested in the previous paragraph, not all issues should be tackled by training the teachers; system and interface design must minimise usability problems too. Some of the findings from this study have fed into work on redesigning the interfaces to a number of conferencing tools. The main idea behind this re-design is that users bring to their work with a computer system a model based on general knowledge and knowledge of the task they are trying to perform. This model is not always appropriate; misconceptions embedded in it can lead to problems in using the software. Interface designers can facilitate the acquisition of a more appropriate user's model by choosing labels compatible with the user's general knowledge and the tasks to be performed. Clark and Sasse (1997) provide an example of successful application of this theory of conceptual design to an Internet tool.

The main message, however, is that training is needed if teaching and learning with such systems are to be optimised. Such training must extend beyond operating the controls and it is likely that a good programme would cover all the areas outlined above, as well as a number of discipline-specific topics. Some areas can be dealt with quickly but many require discussion and reflection, which takes time.

Not surprisingly, time is also needed to develop expertise in teaching with such systems. However, this should not be seen as discouraging. Reasonable performance can be achieved quickly, provided the system is designed appropriately. As was found with the use of a "minimal manual" by Anderson et al (1993), it is not necessary or advisable to introduce every possible function at the start. A more gradual approach is particularly well suited to in-service training. In higher education, even new recruits must learn while in service, whilst in every sector established staff need training to respond to change. Also encouraging is the fact that small-scale, discipline-specific trials can generate material that is more widely useful in staff development.

Teachers are highly skilled experts. They can be introduced to new technology without being made to feel de-skilled or lacking in competence. The teachers in this project have shown that they can participate in system design and shape the technology to suit their needs. In follow-up work, it is also the teachers and students who will select the materials to train others. However, an unexpected benefit is that members of the development team have gained greater understanding of the teachers' domain. Perhaps this will enable them, too, to train teachers effectively?

Finally, the focus of this paper has been on the tutors' learning. At times, the literature (such as Williams (1994)) suggests there is a conflict between evaluating educational software as a tool for the teacher and evaluating it as a tool for the learner. In the type of real-time system under discussion, however, the participants interact throughout. The approach in this project has been to involve students fully and the expectation is that they too will benefit from further work in this area. Interestingly, they regarded the fact that their teachers were, like them, learning to use the technology as a positive and equalizing factor.

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Towards a New Pedagogy for Information Technology: A Report on the IT and Motivation Project - 1995/97

Tim Denning
Keele University

The conference delegates settled comfortably in their seats as the speaker rose to begin his presentation. "How many of you can think of a piece of educational research that has changed the way that you teach?" he asked. Not one hand was raised....
IT and Motivation Conference, Coventry, England 1995

This paper documents some of the outcomes of an IT and Motivation study conducted in nine secondary schools (pupils aged 11 - 16) in England and draws on a more extensive report prepared by the author for the National Council for Educational Technology (NCET) in the United Kingdom who funded the project. (Denning, 1997). The project was established following a pilot study undertaken in collaboration with the City of Birmingham Education Committee during 1994/95 and explored staff and pupil perceptions of Information Technology (IT) and the particular characteristics of IT use that motivate learners.

A guiding principal throughout the project was a concern that the experience and understanding of established teachers should underpin and inform the work at every stage and that the outcomes should be of direct practical significance to classroom teachers and others who use IT to support teaching and learning.

This strong relationship with practical teaching and learning activities was made possible by the generous help and support of teachers and local education authority officers in West Sussex, Sheffield and Birmingham and runs as a thread through all the elements of the investigation.

Setting the Scene

It is clear that the nature of motivation is complex and the author would not wish to claim that he has done more than probe some small component of a much wider domain. For the purposes of the project I adopted a definition proposed in 1955.

'Motivation has to do with "how behaviour gets started, is energised, is sustained, is directed, is stopped."' (Marshall Jones, 1955)

This provided a gentle focus that was broad enough to accommodate the wide variety of contexts and activities encountered during the project. These ranged from the enthusiastic pupil, "*You press a key and WOW it is up there (on screen) - it is like smoking - you get addicted!*" to the adult learner, "*The computer 'listened' without judging me in any shape or form.... I was the one in control.*"

A day conference of all the participating schools and non-school organisations was held in the summer of 1995 to launch the research. This provided an opportunity to set out themes and priorities and to give an initial impetus to the school and non-school institution based work. This was conducted during the academic year 1995 to 1996 and incorporated three concurrent elements or strands comprising questionnaires, school based action research and pupil interviews.

Survey Questionnaires

The first strand, which was also part of the earlier pilot study conducted in Birmingham England, was based on the already established attitudinal survey of pupils developed at the Centre For Successful Schools at Keele University in the UK (Johnson & Gough, 1996). This questionnaire was extended to include 15 extra items designed to gather information about the pattern of IT use experienced by pupils and their views of how this helped or hindered their work.

At the same time a staff survey questionnaire was used to gather information about current levels of IT use in the project schools and staff views on the impact that using IT can have on the process of teaching and learning.

Action Research in Schools and Other Training Organisations

The second strand provided a firm anchor in the real world of school and training. Staff from each of the organisations in the survey were provided with funding and

professional support so that they could conduct an IT focused action research study of their own choosing.

Interviewing the Pupils

The third and final strand was provided by interviews with pupils in schools. These were conducted in many of the schools alongside the action research activities and provided a rich vein of material that has added perspective to the results of the survey work. The interviews were all conducted using a standardised set of questions to prompt discussion and the text of the notes taken during the interviews was agreed with the participants when each session concluded.

Summary of Results - Survey Questionnaires

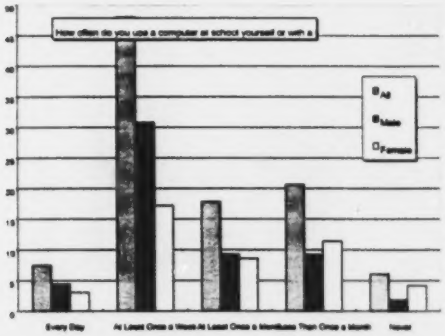
The staff and pupil surveys were conducted in 9 schools in three English local authorities. Responses were analysed for 1313 pupils and 287 staff.

Pupil Survey

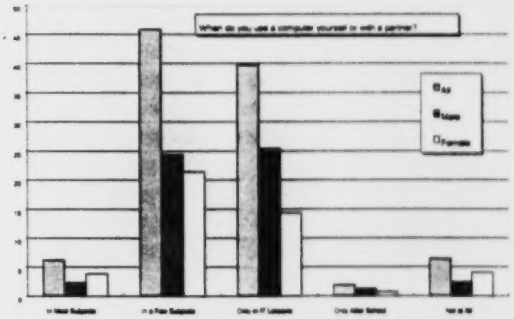
The results of the pupil survey can be considered under two broad themes: levels of IT access and use experienced in school and at home; and pupil perceptions of IT and it's use in their lessons.

IT Access and Use. Pupils were asked to indicate how often they used a computer at school themselves or with a partner. This phrase was used in order to discriminate between individual use or use with a partner on the one hand and those occasions when computers might have been employed for demonstration or class level activities on the other.

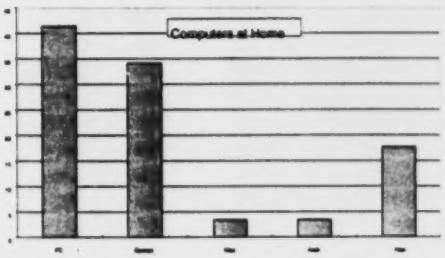
An encouraging 55% recorded use of at least once a week or more with 7.5% indicating that they used computers every day. By contrast, it is disturbing that 6% claim never to use a computer and about 21% suggest they use computers less than once a month. The National Curriculum for England and Wales makes access to a programme of study in Information Technology Capability mandatory for all pupils from 5 to 16.



The next question sought to establish the curriculum context for the IT activities undertaken by individual pupils. The largest group, 46%, indicated that they used computers in at least a few subjects while 40% of pupils recorded computer use only in IT lessons and nearly 7% in most subjects. Some 7% indicated that they made no use of computers at all confirming the low levels of access reported in the responses to the earlier question.



The final question in this section asked pupils to indicate whether or not they had access to a computer at home. This question had proved problematic in the pilot study and was revised to distinguish between 'games' machines and mainstream computers such as PCs and Macintosh systems. The Archimedes computer used in some UK schools was also included.



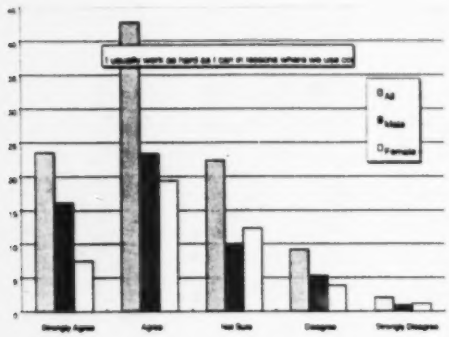
Some 83% of the pupils reported some form of computer available at home and although 34% described the computer as a 'games' machine 42% of the pupils claimed to have access to a PC.

Pupil perceptions of IT and motivation

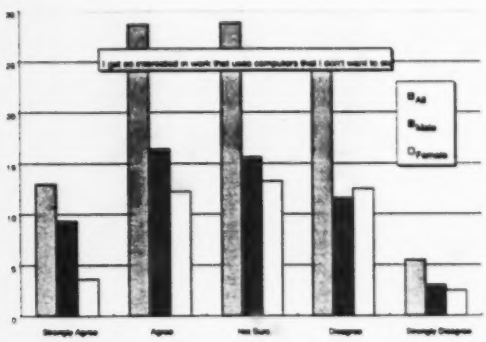
This group of questions was developed from a family of questions in the attitudinal survey that provide information about pupil perceptions of their learning experiences and their readiness to learn. For the purposes of the project these were 'contextualised' by incorporating the use of computers in the question stem. For example, the question "I usually work as hard as I can in lessons" was modified to become "I usually work as hard as I can in lessons where we use computers".

I usually work as hard as I can in lessons where we use computers. This first question asked for responses to the proposition that pupils work as hard as they can in lessons where computers are used. Nearly 65% of all

pupils responded positively to this suggestion and whilst a distinct gender difference is apparent here this may be a feature of a general tendency for boys to affirm more strongly than girls in questions of this type.

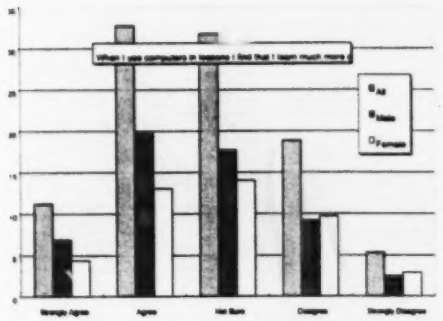


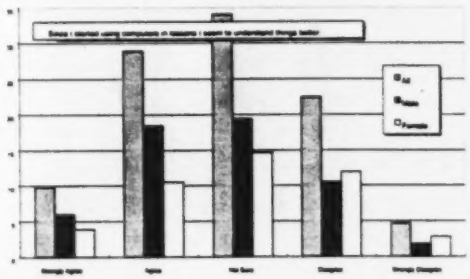
I get so interested in work that uses computers that I don't want to stop. In the responses to this question 43% of all pupils claimed that they can get so interested in work with computers that they don't want to stop. This compares with only a 16% response to the equivalent question in the general survey that was set in the general context of 'work at school.



Three further questions were used to probe the relationship that pupils see between their use of IT and their level of understanding, interest and learning. More than 70% of pupils responding to these questions agree that using computers makes lessons seem more interesting whilst more than half agree that using computers seems to help them 'understand things better' and a similar number that 'they learn much more quickly'.

It is, however, important to be cautious when interpreting these responses, they represent pupils' self reported views about the use of computers in their learning and need to be explored further with an objective evaluation of real learning outcomes and improvement.



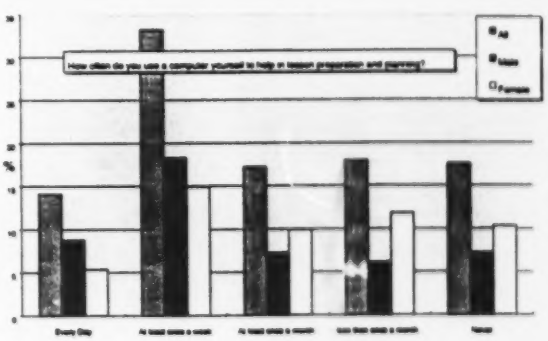


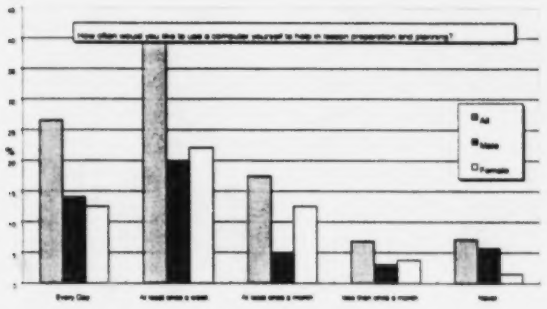
The Staff Surveys

The first four charts drawn from the staff survey results deal with current and 'potential' levels of IT use. The questions ask staff to consider how much use they currently make of IT as personal tools in their lesson preparation and how often they deploy IT to support their teaching. In each case the questions that follows provides an insight into how frequent the 'actual' level of use is compared with the levels they would aspire to. It is here that the disparity between current and sought after levels of use in classroom activity becomes most obvious.

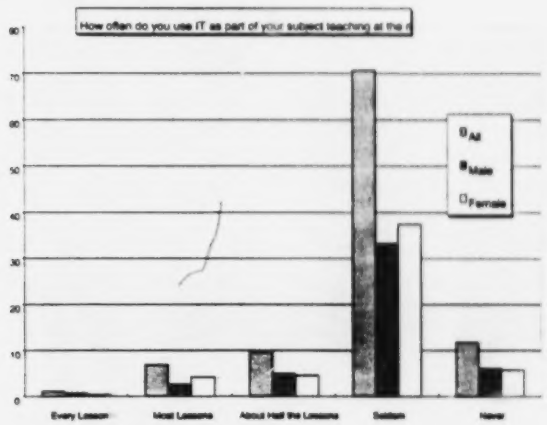
The scale of this unfulfilled aspiration suggests that there remains a very significant opportunity to make much wider and more effective use of IT to support teaching activities.

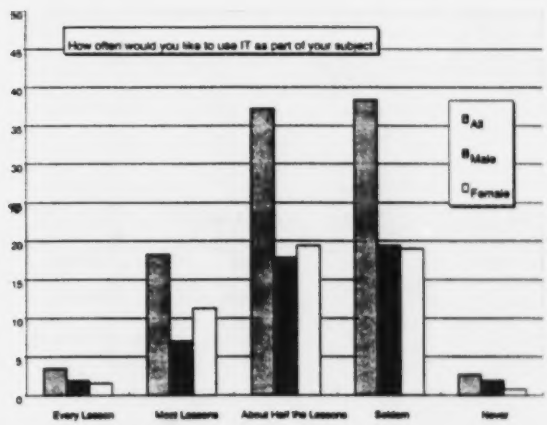
IT in Lesson Preparation





IT in the Classroom





The ambition of many of the teachers in the survey sample to make wider use of IT to support their work in the classroom suggests that there is considerable potential for expanding the current levels of IT activity across the curriculum in England and Wales. Currently some 20% of staff surveyed would claim to use IT in half their lessons or more. This figure rises threefold to 60% when staff are asked to indicate the level of IT use they would 'like' to achieve.

The staff questionnaire also asked staff to indicate if they had received any training in the use of IT. These results show that staff who have received some form of IT training are more than twice as likely to use IT in their lessons than those who have none.

Interviewing the Pupils

The interviews with pupils established firmly that there is almost universal enthusiasm for the use of IT to support work in schools. The quality of the unprompted comments was almost always high, demonstrating a sophisticated and well-informed view of the technology and its use.

Although some pupils were evidently impressed by the technology itself, the majority of comments were more concerned with the process of communicating and handling information and the high standard of presentation that could be achieved.

The following comments were typical:

- *It looks real ... it's interactive and you can change the view*
- *You can try new ideas and change things later*
- *It takes longer at first but you can do more with it*
- *It is easier to use work again and change it for different things*

A number of common themes emerged in the pupil comments echoing many of the features of motivated activity described in the literature. These included: a sense of empowerment and autonomy; improved self esteem; moderate levels of challenge coupled with fairly immediate satisfaction at having 'got it right'; and the freedom to operate in a non judgmental environment, i. e., 'the computer doesn't shout if I get it wrong!' A number of pupils felt that using IT made information more accessible or more 'valid' than traditional sources.

- You get control over this machine (feeling of power)
- You can try new ideas and change things later
- It makes you think because you are in control
- It takes longer at first but you can do more with it
- It doesn't mind if you make mistakes
- ... drawing the graph makes it easier to understand (what is going on)
- You understand it more because you get a clear set of results

At one school the interview groups had been selected on the basis of their apparent lack of interest in IT activities. Discussion with these pupils soon revealed that the absence of motivation was frequently related to both the nature of the tasks set and unfavourable comparisons between the poor level of technology available in school and the generally better resources available at home. These negative views were expressed in a number of schools.

We spend too long going over what to do and the tasks are not worthwhile

It is frustrating (echoed by all) - you know how to do it at home but the school programme is different

The school computers do not have enough power

The work is too complicated for the results we get - could do it better with a pencil

The system is much too slow - it takes a long time for changes to show

Tentative Propositions

Maximum motivation score is achieved where IT is used in a range of subject contexts An 'index' of motivation was constructed by combining the responses to a group of related questions in the Pupil Questionnaire. The 'index' score, maximum value 100, is 72 when IT is used in range of subjects, compared with 58 when IT usage is confined to IT lessons.

Most pupils were enthusiastic and well informed about IT. They commented frequently on the benefits of **using** IT in a purposeful way, concerned more with utility than the more superficial features of the technology such as speed, modernity or colourful screen presentation.

Autonomy, self esteem, challenge and the timely confirmation of success are all-important features of IT based activities. Pupils are motivated by positive experiences of using the technology for a range of activities and the fact that the computer is non-judgmental.

Some pupils were demotivated by the poor quality of IT resources in school compared with those available at home. 83% of pupils say they have some form of computer at home. More than half of these are reported as 'Windows' capable PCs.

Patterns of IT use across the curriculum are very variable with some 40% of pupils only using computers in IT lessons. Better information about the deployment of IT resources, the use of specialist staff and the level of effective cross-curricular use is needed.

Only 20% of staff surveyed use IT regularly in lessons although 60% of staff in the survey say that they would like to use IT in at least half of their lessons and 80% of staff who use IT regularly find that pupils are well motivated

The range and suitability of IT tasks can be a source of concern. Pupils sometimes see tasks as repetitive and unchallenging. There is often little time to embark on worthwhile activities. Teachers need clear guidance and support if IT use is to lead to more effective teaching and learning.

Acknowledgements

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Internet Readiness: Preservice Teachers' Attitudes to High Technology in Schools

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This paper examines the views and attitudes of student teachers (that is, preservice teachers) regarding the use of information technology, and in particular the Internet, as a resource for teaching and learning. It focuses on the declared beliefs of the cohort of students currently taking preservice teacher education courses at Trinity College Dublin, Ireland; and it investigates aspects of their readiness to implement newly announced policies on information and communication technologies (ICTs) in education. The work provides a case study of a system in transition, and offers a set of snapshots — or perhaps video excerpts — of the attitudes these student teachers bring to the course with regard to ICTs and their potential as an educational resource.

Ireland has a fairly long history of use of ICTs in schools, but a comparatively limited record in formulating official policy in the area and in providing resources. Policy and provision are now being addressed; ambitious plans have been announced (Department of Education and Science, 1997):

- to establish appropriate resources, including multimedia facilities and internet connections, in all schools;
- to introduce programmes for enhancing teacher education; and
- to provide backup, in terms of both human and electronic support mechanisms, for use of ICTs in teaching and learning.

Thus, an important movement is in progress: from "free enterprise" to "national prescription." It is a truism to say that the teacher education element will be crucial in the success of the plan. Older teachers at least have pedagogical experience to support them; but people involved in initial teacher education need to look at the readiness of student teachers, especially those that had little experience of ICTs in their schooldays. This paper contributes to such examination.

The background to the study — historical footage, so to speak — is provided in the first section. This briefly outlines the ICT provision in the school system through which the student teachers came; it then describes the knowledge and attitudes of past student teachers at Trinity College in the context of the provision made for their ICT education over the years. The methodology of the present study is described in the second section. As the new project "Schools IT 2000" was launched (after some delay) only at the end of November 1997, the later parts of the study had not been carried out when the present version of the paper was written. However, the third section contains "snapshots" from the first part of the study, dealing with students' prior experience of ICTs and with their views of ICTs in education *before* the impact of the initiative was felt. Some tentative conclusions can be drawn; an updated paper will be provided when the work is presented at the SITE conference.

Historical Footage: ICTs in the Irish Education System

It is not the purpose of this paper to give an account of the development of ICTs in Irish education over the past thirty years; such an account can be found elsewhere (National Council for Curriculum and Assessment, 1993). However, given the view of Knowles (1992) that teachers are trained in the classrooms they attended as pupils, a brief summary is relevant. While Ireland did not take part in the IEA COMPED study, its descriptions of education systems which make only restricted instructional use of computers fit the country well (Pelgrum & Plomp, 1991).

> Moves at national level have given [ICT] education a place in the country's education system. However, developments have been heavily constrained by lack of resources and *notably short on policy and planning at the highest levels* [emphasis added]. The results can best be described as "patchy"; some schools, teachers and students (at both primary and post-primary level) are involved in work that has drawn international recognition, but others have not yet made a start (National Council for Curriculum and Assessment, 1993, p. 12).

The lowly official position of ICTs up to now has posed problems for preservice teacher education, and especially for the preservice education of *secondary* teachers (teaching grades 7 to 12). Secondary teachers are

educated using a "consecutive" model. After completing their degree, they take a one-year diploma during which they typically spend half of each week in schools, often in charge of classes. They therefore tend to focus on the immediate needs of survival in the classroom, rather than on issues they may regard as peripheral to the institutionalised curriculum.

Some dozen years ago, the authors of this paper accepted their own lack of success in trying to inspire such students with a vision of education in the information age. Instead, they addressed students' own perceived, or easily recognised, needs: in particular, their need to prepare teaching/learning materials and to keep records of pupils' test scores. Thus, a cornerstone of ICT policy in the course became the requirement that each student could demonstrate basic word processing — and, later, spreadsheeting— skills. Research conducted over the following years highlighted the necessity for the exercise. As recently as 1990-91, one-third of the class reported never having used a computer before. Their feedback on the exercise was generally encouraging, with students making assertions such as "At first I was nervous but now I think it's fun" and "As wordprocessing is such a useful tool for a teacher to have, I will be using computers in the future" (Oldham & FitzGibbon, 1992). In particular, some who had had negative experiences of programming changed their attitudes; and while not all students were enthusiastic, with some falling short of mastery ("I still feel I am incompetent") or, rarely, expressing strongly negative feelings ("I detest computers"), the relevance of the *tool for teachers' own work* was widely acknowledged (Oldham & FitzGibbon, 1993).

For *primary* level (best equated to grades K to 6), most teachers are educated using a "concurrent" model; they take a Bachelor in Education degree in which teaching practice occurs at discrete intervals. Thus, by comparison with secondary student teachers, those at primary level are less preoccupied by "survival in class the following day." However, a very broad curriculum — in which courses in the core disciplines of education (philosophy, sociology, history and so forth) are still a requirement for qualification — leads to a danger of overload and hence to difficulties of another kind in accommodating meaningful experience of ICTs.

Primary student teachers at Trinity College study the core disciplines on the main campus but do the rest of their work in Colleges of Education associated with Trinity. The second author lectures part-time at one of the colleges, offering a short compulsory module on ICTs in education to students in the second year of their three-year course; separately, students are also taught some basic skills. The lecturer's impression has been that the ICT module has had a rather limited impact. However, nowadays many students appear to accept and even welcome the basic skills training, and to use the skills for instance in preparing materials for their teaching practice; that is, again, they have recognised the importance of the *tool for teachers' own work.*

Against this background, the main research question addressed in the present study is whether — in the current climate of increasing access to powerful ICT facilities — there has been a corresponding change in acknowledging the relevance of ICTs, especially the internet, as *resources for teaching and learning.*

Methodology

The study was designed in two parts, to be carried out respectively immediately before and some time after the announcement of the initiative "Schools IT 2000": hence, to capture the students' views respectively before the content of the initiative was known and after its implications had become clear. As indicated above, the launch of the initiative was delayed (by a change in government), and the paper in its present form therefore refers only to the first part of the study.

For that first part, data were collected by means of a questionnaire administered to most classes of preservice student teachers at Trinity College. The groups involved were:

- intending [preservice] secondary teachers;
- intending [preservice] primary teachers in their first, second and third year of study (the students based in the College of Education at which the second author teaches);
- a small group taking a post-graduate course which would qualify them as primary teachers; and
- a group of students who had already completed the Ordinary Bachelor's degree but were taking a fourth year of study, while teaching, in order to raise the degree to Honor level (and still describable as "preservice" teachers because most were doing the Department of Education diploma that completes their qualification).

A subset of the latter group was used for pilot purposes. The final version of the questionnaire had two main sections. One dealt with the students' experience of ICTs in the school system (and, for graduate students, in third level education before entering their current course). A further question asked the students to describe their level of ICT literacy in broad terms: highly literate, somewhat literate, barely literate or illiterate. The other main section of the questionnaire asked about their intentions regarding their, and their pupils', use of ICTs in their first year of teaching, in five years' time, and in ten years' time. It also included a semantic differential section designed to investigate the students' view of the impact of ICTs on aspects of the education system in general, and an open-ended question asking them to describe the Internet and its

possible role in education. The intention was not only to collect baseline data, but also to identify groups, individuals and issues for further study in the second part of the research.

Students were given time in lectures in which to complete the questionnaires. The data were entered into an Excel spreadsheet; categorical and quantitative data were analysed using Data Desk, while the free-response questions were processed by hand.

Results: Snapshot of Students' Readiness

Responses were received from 195 students: 66 intending secondary teachers; 36, 23 and 19 students respectively from the first, second and third year primary course; 11 from the post-graduate course for intending primary teachers; and 40 from the "Honor" group. This represents a response rate of around 60 per cent, with the shortfall being accounted for chiefly by absence from the relevant lectures on the (very wet!) days in which the questionnaires were administered. Of the 189 students declaring their gender, 163 were female and 26 male. The mean age was 22.5 with a standard deviation of 5.0; eleven of the first year students were only 17 years of age, while the oldest student, an intending secondary teacher, was 50.

Results of interest at this stage have been picked out for comment, rather than presented in statistical form, and are described under three headings: prior experience, intended use and effect on education, and metaphors for the internet and its use.

Prior Experience

If Knowles (1992) is correct in his view — quoted above — that teachers are trained in the classrooms they attended as pupils, then the current cohort of student teachers is ill-prepared for using ICTs as *a tool in teaching and learning*. Only nine reported such use from their primary schooldays, and while 46 did so from their second level experience, this figure arises largely from use in teaching computer skills. In terms of high-end technology (such as multimedia and the web), the older students could not have experienced it in their schooldays, but the younger ones were not much better off. Altogether, in fact, small numbers of web users (not necessarily users in an educational setting) were scattered over all the classes.

However, the intending secondary teachers do have considerably more experience of computers than did their counterparts five to ten years ago. While only slightly more than half the respondents reported some exposure in their schooldays — almost always at second level, and generally slight and focused on *skills* — nearly all used computers (typically for word processing) in their third level colleges before entering their teacher education course. Their modal choice for their present level of literacy was "somewhat literate."

The intending primary teachers are less well prepared. While exposure at second level is growing (in general the more junior the students have greater exposure), and while some exposure at primary level was reported, again usage was generally slight. The first and second year students, who had yet to be given their main ICT inputs on the teacher education course, gave their modal choice of literacy level as "barely literate." The Honor cohort's modal description was also "barely literate" despite their experience in their various colleges during their Ordinary degree years. This substantiated the feeling, reported earlier, that the ICT module taught by the second author has not been as effective as would be desired; and the same may be true of equivalent work at the other associated colleges. However, for the third year students — who had not only attended their second-year module on ICTs in its most recent form (and experienced some usage in other College courses), but coincidentally had just been evaluating a piece of mathematics education software as part of their Mathematics Teaching Methods course — the modal description was "somewhat literate": hopefully, a move in the right direction.

Intended Use and Effect on Education

While the questions on the future role and use of ICTs did not demand detailed identification of the activities involved, students at least showed an openness to development rather than a technophobic response. Indeed, in comparison with findings from earlier studies (Oldham & FitzGibbon, 1992; Summers, 1990), technophobes were few. Over half the group strongly agreed, and only one disagreed (with none at all strongly disagreeing) that "computers are very relevant to the future of education." In terms of the extent of their own and their pupils' use of computers in general and the internet in particular, both for personal work and in class, predictable patterns of increase over the next ten years emerged. More than other groups, the Honor primary cohort — already teaching as well as studying — tended to foresee usage "never" or "often" (rather than "occasionally"), notably in the short term; this may reflect respectively poor or good facilities in their schools.

The semantic differential section of the questionnaire asked students to indicate their view on a scale of 1 to 7 between two stated extremes: for example "ICT improves education ... ICT disimproves education" — there was a high level of endorsement for improvement. Students were fairly equally divided as to whether ICTs would increase the teacher's workload, decrease it, or leave it unchanged. Several items addressed the issue of the teaching/learning environment, and again the results displayed an openness to change. There was a clear tendency to envisage classes becoming more student-centred (rather than more teacher-centred); creativity was seen as being encouraged (rather than inhibited); equally, the involvement of new teaching and new learning strategies was strongly endorsed, though one-fifth of the intending secondary teachers saw tradi-

tional teaching strategies as being involved — perhaps reflecting the dominance of traditional teaching under the pressures of the national examinations in the upper grades. There was a less clear tendency in support of general enrichment (rather than impoverishment) of the environment, with the intending secondary and the Honor primary groups — the two groups most regularly in classrooms at the time of data collection — being most cautious; and there were differences both between and within the groups regarding whether student-student rapport would be increased, with the third year intending primary teachers being the most positive. ICTs were viewed as encouraging (rather than inhibiting) curriculum change, but other items dealing with system level issues elicited many neutral or "don't know" responses; perhaps student teachers cannot yet focus easily on national or global issues.

Metaphors for the Internet and Its Use

To start with the bad news: a small cluster of students scattered across the different classes denied having any information regarding the Internet and its uses. Their responses included: "I don't know" (most common within this group), "completely ignorant" and "not familiar with it." Others were willing to attempt a reply but unadventurous in their descriptions of and metaphors for the Internet. Two favourite metaphors emerged: "encyclopaedia" and (poetically but rather simplistically!) "information at the touch of a button." "Encyclopaedia" had qualifiers such as: huge, infinite, vast, ever changing, up to date.

The uses can be categorised under three headings: information, communication and education. *Information* concerns are exemplified in the two metaphors discussed above. The downside was recognised by some students who mention, for example, "utter rubbish available," but most were uncritical and in apparent awe of the range of information: "wide range of topics" and "access to other cultures and traditions." The information was seen as "constantly changing" and "updated as it happens." *Communication* was viewed as being between people and between schools, as being direct and worldwide, creating a "community of people" and leading to "a multi-cultural correspondence."

The specifically *educational* uses are interesting. The opportunity for increasing the personal autonomy of the learner was clearly realised, as was the possible role of technology in "develop[ing] children to be more independent thinkers" who can "discover the world without the limitation of the teacher's knowledge." The teacher "falls into the background"; the need for teacher education was identified. The Internet was seen as motivational, being "a creative varied means for learning and teaching" which the children enjoy ("children are hooked"). Two students, in the secondary teachers' group, were dubious of the value of the Internet in primary education, a view not endorsed by their primary colleagues.

Conclusion

With the announcement of the policy encapsulated in "Schools IT 2000," there are interesting times ahead for those concerned with ICT education in Ireland. The snapshots described above indicate the need for much work before new entrants to the teaching profession are ready to avail of enhanced facilities and to integrate ICTs into their teaching in a meaningful way. While students displayed considerable goodwill towards ICTs in education and acceptance of coming change, the nature of the data collection exercise was such that they could respond "naively" — without having to tease out what their responses would mean in terms, for example, of their day-to-day classroom work or of reconceptualisation of their approach to teaching. Such issues will be addressed in the second part of the study, to be conducted in early spring 1998 by using focus groups of selected students. It remains to see if the apparent general goodwill and good intentions regarding the use of ICTs, as revealed by the initial snapshots, can be translated into genuine commitment to the appropriate use of ICTs in education in the time to come.

Acknowledgments

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An ICT Competence-based Environment for (Re)training Educators in Educational Innovation and Technology

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Higher education - be it academic, vocational or professional - should ensure that students attain a certain level of competence upon completion of their studies to allow them to function intelligently, independently and flexibly within their chosen profession. Graduates should reach a point where they are capable of choosing an adequate response or action from a variety of possibilities in a variety of situations, and of correctly carrying out these actions in order to achieve their goals. As such, competence is defined here as a unique combination of knowledge (knowing what, how, when and why) and skill (being able to perform certain actions) in a goal directed way in a specific situation or context (Kirschner, Vilsteren, Hummel, & Wigman, 1997).

Educators are just such professionals. It is no longer enough to longer simply 'teach'. Educators are constantly being confronted with new demands on their functioning. New tasks are constantly being added to their job descriptions. This situation is due to the ever-increasing tempo of changes in the educational system, school organization, society, technology, educational content or all of these combined. It may also be the result of the never-ending stream of pedagogical problems that each individual educator confronts in his or her 'normal' classroom situation. In order to survive, the professional educator must be flexible and be able to continually adapt and evolve. In other words, the teacher must become an educational innovator.

Learning to innovate requires a learning situation where the learner can acquire necessary knowledge, skills and attitudes in a real life, recognizable and meaningful context. This combination, together with the ability to make an adequate choice from a number of possibilities/ possible actions in different situations, we consider to be a competence. Only in this way can traditional teachers be transformed into reflective practitioners, able to adapt their teaching to any and all changes that confront them. In other words, to be practitioners who are able to systematically reflect upon their situations and flexibly (re)design their education by offering their learners effective learning paths and pedagogic instruments to assure high quality education.

This ability to innovate is not only necessary for those who teach, but also for educational managers (heads of schools, et cetera). They are the ones who, on the one hand, create the necessary conditions for educational innovation and on the other hand establish policy that is an adequate reaction to external influences on the school. In other words, the educational manager must be able to (re)design education and manage innovation at the meso-level.

Premises of the Environment

The information and communication technology (ICT) environment for (re)training educators in educational innovation and technology is based upon:

- teaching what/as one preaches;
- competence acquisition / skill development / knowledge gain;
- a study environment (student centered) instead of teaching environment (teacher centered);
- just in time instead of just in case;
- task based, situated, contextual learning;
- flexible education for different groups;
- producing reflective practitioners of educational design;
- integration of learning, instruction and testing (intake, progress and certification);

- affective aspects of innovation;
- collaborative learning as precursor to collaborative teaching;
- educational innovation and design as integral processes;
- process en product evaluation integrated in the process;
- the premise that innovation never stops; and
- structural use of ICT as a tool in the (re)training program and in education.

Competencies

At this moment the teaching profession, from kindergarten through college and university, is a topic of discussion and change within the Netherlands. The government has installed a number of official working groups to redefine the profession and redesign the educational programs for initial certification and retraining. Based upon a thorough review of official memoranda and reports of the Dutch government and professional organizations we comprised a list of competencies relevant to being/becoming a professional educator. These competencies are:

- The ability to determine (via analysis) those aspects of classroom, school and societal situations and developments which influence the educational process (problem definition) so that possible solutions for the problems as well as adequate implementation strategies for the necessary changes can be evaluated and implemented. In other words the ability to adequately react to the challenges of the profession and of society with respect to the organization of education at the classroom and school level.
- The ability to work with others to design innovative changes in education which are necessary to meet the specific needs or requirements of the class, school, school board or government.
- The ability to work with others to develop innovative changes in education which are necessary to meet the specific needs or requirements of the class, school, school board or government.
- The ability to work with others to implement innovative changes in education which are necessary to meet the specific needs or requirements of the class, school, school board or government.
- The ability to manage the process of innovating education (from initiation through implementation to evaluation) at the classroom and school level.
- The ability to apply those aspects of educational theory, educational psychology, pedagogy, and didactic theory for designing, developing and implementing education.
- The ability to functionally apply (both effectively and efficiently) modern information and communication technologies at the classroom and school level.
- The ability to develop into a life long learner with respect to one's own profession as teacher or educational manager.

Cognitive skills that are integrated into the (re)training program are: Analysis, Synthesis, Evaluation, and Reflection.

Required attitudes and affective skills that will be integrated into the (re)training program are: adaptivity, life long learning, professionalism, confidence in one's own possibilities, and professional cooperation.

Educational design

Educational design (as profession or study) must try to achieve a balance between praxis (the craftsman) and empirical science through a methodology based upon the regulative (van Strien, 1986) and reflective cycles (Van Aken, 1996). According to Van Aken, the job of the professional is the solution of a unique problem within a specific situation. He or she does this via a cycle encompassing: problem choice, diagnosis, planning/design, operation/implementation, and evaluation.

By working one's way through the regulative cycle, the professional makes use of reflection-in-action (Reflective cycle: Van Strien, 1986). This cycle makes use of a series of 'cases' to develop design knowledge and skills (heuristics). Reflection is directed towards detection of new solution possibilities for problems and as such is primarily busy with a not existing reality. In this cycle, the practitioner selects a specific case, applies the regulative cycle, reflects upon the results of his or her actions and then chooses a new case from the original class of cases.

A loose integration of these two cycles forms the basis of the educational design of the (re)training environment (see Figure 1.).

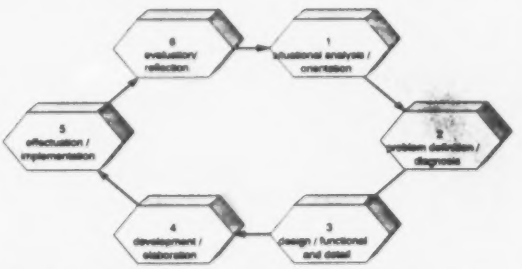

Figure 1. Approach for the Use of Problems and Cases in the (Re)Training Program.

If Van Strien and Van Aken provide a good educational design, Kolb's learning cycle (Kolb, 1982, 1984; Kolb, Lublin, Spoth, & Baker, 1986) seems to present a good pedagogical basis for training 'reflective practitioners'. As such it is the second pillar of the study environment. Kolb's learning cycle is based upon 'experiential learning', learning *while* doing. This should not to be

confused with "learning by doing. Learning by doing implies that by doing something one will gain the necessary background knowledge and skills by oneself. "Learning while doing" implies that the learner is presented the necessary knowledge and skills at their most relevant moment during the experience. The experiential learning method creates an environment that requires the participant to be involved in some type of personally meaningful activity. Such an environment allows the participant to apply prior knowledge of theory and principles while developing commitment to the exercise and experiencing a real sense of personal accomplishment or failure for the results obtained (Walter & Marks, 1981). This type of learning resembles the previously described approach, but emphasizes personal experience as the basis for conferring meaning to knowledge and skills. In order to bring about behavioral, attitudinal, and knowledge change, Kolb advanced a circular, four-state experiential learning model. Learning can start at any point in the cycle, but must go through all four activities.

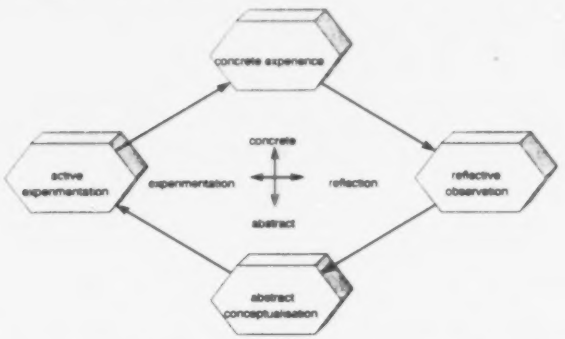

Figure 2. Kolb's Experiential Learning Cycle.

The learning activities take place along two dimensions: concrete experience versus abstract conceptualization and active experimentation versus reflective experimentation (Urban, 1992). Within the study environment the learner makes use of:

- concrete experience: the learner experiences the results of his/her active experimentation and is open for those experiences;
- reflective observation: the learner observes the situations from different perspectives (the results of the experience) and reflects upon them;
- abstract conceptualization: the learner integrates these perspectives in logical theories and explanations; and
- active experimentation: the learner tests the theories in practice.

Structure/Design

Educational innovation and technology as content domain is not based upon some abstract, academic or historic conceptualization of the domain, but rather upon a set of professional competencies needed by the reflective practitioner. These competencies are interrelated and form a competency map.

Composing a curriculum means selecting competencies according to certain criteria. In our environment, each competency can be achieved by working through one or more case studies or problem situations. The choice of case or problem depends upon such student variables as function (teacher /principal/et cetera), study aim/objective (teaching better/innovating one's own teaching/adapting the school organization/aspiring to another job/and so on), type of school (elementary/high school/adult and continuing education) and so on.

A number of parameters are distinguished within each case that are related to other student variables such as prior education or prior knowledge. The case can be automatically adapted to all of these parameters with respect to:

- its formulation,
- the tasks required,
- the study support devices offered, and
- the products and performance for assessment.

The global design of the environment can be seen in Figure 3.

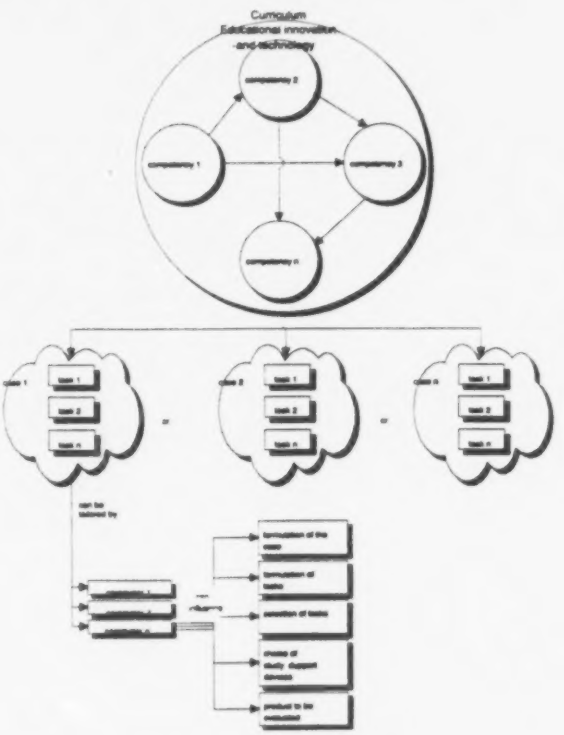

Figure 3. Global Design of the Environment.

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Summing up

Summing up, the (re)training program:

- is based upon competencies that are linked to (clusters) of tasks within the study environment;
- makes use of 'just-in-time' knowledge and skills acquisition;
- is adaptive with respect to student learning style;
- is adaptive with respect to the prior knowledge of the student;
- is based upon the regulative and reflective design cycles and Kolb's learning cycle;
- contains the necessary study advice to stimulate, facilitate and promote learning;
- is aimed at the stimulation of reflective activities and the acquisition of attitudes; and
- makes use of well defined and well ordered study tasks.

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Course-based Desktop Videoconferencing between the United States and Norway

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What if your students could receive lectures in your course from internationally recognized experts and ask them questions after class, all without you having to pay for their travel expenses or arrange a satellite downlink to a specially equipped classroom reserved a year in advance? What if your class could have a face-to-face discussion of a case study with peers in another country to see how the values and contexts of another culture lead to similar and different perspectives on issues and solutions? Then they repeat the experience the next week with colleagues in a different country. What if these same students could continue their interactions outside of class, exploring their own personal and professional interests further? What if students in elementary and secondary schools could have similar opportunities to participate in multiple, extended interactions during their lessons over their school careers? How could students' educational experiences be transformed? What would be the impact on learners? How could it expand your teaching?

A variety of current, commonly-used applications of the Internet and the World Wide Web begin to provide low-cost opportunities for university and K-12 students to interact with their peers at distant locations in educational situations. These applications include electronic mail, chat rooms, asynchronous discussion boards, whole courses with audio and video delivered via Web pages. We have found that these instructional options, though, can only cultivate the social, human side of the interpersonal relationships that are the basis of all educational interactions so far because they lack the capacity to provide live, real-time audio and video interactions between the participants.

Desktop videoconferencing over the Internet—through programs like Cornell University's *CU-SeeMe*, Microsoft's *NetMeeting*, Connectix's *VideoPhone*, and Intel's *Internet Video Phone with Proshare*—provides the capability of inexpensive opportunities for face-to-face human interactions for teaching and learning no matter what the distance. The educational use of these applications, though, has been minimal when compared to their uses in business or to the frequency of use of other Internet and World Wide Web applications in education.

Two projects have been relative pioneers in the educational uses of desktop videoconferencing. The Global SchoolNet Foundation (GSN; see, http://www.gsn.org/) started in 1984, ran the Global Schoolhouse Project sponsored by the National Science Foundation and continues to work to link classrooms and experts around the world in a variety of exciting, videoconferencing-based special projects. Faculty at the University of Virginia's (UVa) Curry School of Education have developed a World Wide Web-based course on interdisciplinary teaching that makes an extensive use of the course's Web site to provide instructional materials and interactions among students enrolled in the course at different universities. In addition the course involves real-time videoconferencing sessions using *CU-SeeMe* among students at various sites (see, http://curry.edschool.Virginia.EDU/go/casecourse/). One drawback that we see in the efforts of both of these projects, though, is that the use of videoconferencing has generally remained a special or isolated event. This event is often separate from or even an interruption of—albeit a very exciting one that is too good to miss—the everyday life of classrooms or the sequence of courses that comprise a major field of study.

This paper describes our course-based uses of Internet videoconferencing between faculty and students at the Norwegian University of Science and Technology (NTNU) and their peers at the University of Minnesota, Duluth (UMD). We provide information about the project, equipment and software, our efforts, and the lessons we learned.

The Project

Our project started when interests met with an opportunity. We in the Department of Education at UMD directly experienced the potential of desktop videoconferencing by participating as a site the first time Virginia offered its

course in spring, 1996. Because of that, we looked for other ways in which we could use this application. NTNU's Department of Education wanted to develop its competence in the instructional uses of technology. In spring, 1997, they hosted Keller as a Fulbright professor of special education. Faculty in the two departments decided to collaborate on expanding the ways in which to use desktop videoconferencing in education and extending its use internationally through sessions with each other. We saw this as a way to continue the educational exchange between Norway and the United States and the comparative examinations of education beyond the tenure of the visiting professorship.

Equipment and Software

To run the videoconferencing, we have used a Windows platform in Norway and a Macintosh platform in Minnesota. We use QuickCams by Connectix and external microphones. Each computer runs appropriate versions of *CU-SeeMe*, shareware created by Cornell University to support videoconferencing on the Internet (see http://*CU-SeeMe*.cornell.edu). We have found this software to be one of the few desktop videoconferencing programs at this time that works across the two platforms. *CU-SeeMe*'s video transmission capabilities have generally been adequate. We have had more difficulties with the audio portion of the application. At times the sound has either been absent or of such low quality that we have had to rely on telephone calls for this part of our videoconferencing sessions.

We also plan to try out other desktop videoconferencing programs from vendors like Intel, Connectix, and Microsoft that can only run on a Windows platform. Some of these contain additional features like white boards and the capability of sharing documents and applications that would be very useful in course-based videoconferencing sessions.

Videoconferencing Sessions

We now describe the different ways we planned to use desktop videoconferencing in our courses over two semesters and what happened with or in those sessions as a way of identifying some of the problems, solutions, and outcomes we have found with our project.

One idea in spring, 1997 was to use videoconferencing to exchange course lectures between faculty at NTNU and an institution in the United States like UMD or the University of Virginia. This could provide NTNU students with direct access to someone with particular expertise—for example, the author of one of their readings—who would not normally be available to them. This author could present his or her ideas. The students could discuss them directly with this person. A reciprocal lecture by an NTNU faculty member would provide students in the United States with another perspective on one of their course topics as well as an opportunity for real-time interaction. During our trial attempts at videoconferencing, we felt that certain characteristics of the transmissions (e.g., slowly altering or even static pictures in the video transmissions; interruptions and extra noises in the audio portion) might impede the delivery of a lecture. Classrooms for such lecture-based courses that were connected to the Internet were not available on the NTNU campus where the Department of Education was located, though extra cables could have been used to connect a classroom to a computer lab where such Internet connections were present. Most importantly, it was difficult with short notice to identify places in course schedules where such guest lectures could occur as well as the personnel in each country who could deliver them.

A second idea during that semester was to have a group of NTNU students participate in the spring, 1997, offering of UVa's World Wide Web-based course mentioned earlier. Here a course structure was already in place that provided opportunities for communication among students at different institutions through *CU-SeeMe* videoconferences. The UVa instructors allowed a group of NTNU students to try out components of the course as a way of seeing how their instructional methods and materials worked with students from another country. We found three masters-level students with interests in instructional technology who volunteered to participate after the course had already started in the United States. Because the course relies heavily on the use of teaching cases as a vehicle for generating course content, an instructional approach that is relatively uncommon at NTNU, the first meetings of the students focused on case analysis. From the beginning the students did very well with the cases, generating insightful analyses that contained a Norwegian perspective on issues and solutions, though they often found it difficult to understand on their own many details of the American contexts of the cases. One student left the experiment, though, because it took too much time to read all the materials in English. The other two students eventually found it too difficult to catch up to where the American students were in the course activities as their involvement was in addition to their already heavy school and work schedules.

The third idea involved having a group of NTNU students in a masters-level seminar in special education discuss a teaching case with a group of peers at UMD. Because of the seven-hour time difference between the two sites, it was not feasible to find a comparable group of educators in Minnesota. Arrangements to connect with a group of preservice, elementary education students for the conference were not successful either because of class scheduling conflicts at UMD and those students' other responsibilities. A group of UMD education faculty and one student, however, volunteered for the session. After a few technical problems were solved, the two groups began their discussion of the case of Lenny, a hyperactive,

American Indian kindergarten student, by presenting different issues that each group saw in the case. The session turned into more of a discussion when one of the Norwegian educators disagreed with the American student's point that Lenny's cultural background should be de-emphasized. The participants then considered how some of the other country's proposed solutions might be difficult to implement in their own educational contexts. The groups started asking more general questions about each other's educational systems when we ended the session after one and one-quarter hours. Students and faculty at both institutions were very excited by and pleased with the videoconference.

Because of this success, arrangements were made for another session. A group of preservice educators from the teachers' college in Trondheim, who either had already participated in or were about to embark upon a year abroad at an American college, discussed the characteristics of a good teacher with a group of preservice, elementary education majors at UMD. This was the final course project for the UMD students. In preparation for this session, students at both schools were assigned the same reading and were to interview pupils in their field placements for their ideas about what makes a teacher good. This proposed topic for the videoconference was addressed but students from both sides often shifted the discussion to other topics of a more general nature, like how the job market was and whether they had to take exams. It seemed as if the participants had to know this basic, contextual information—which was probably more personally meaningful to them than our assignment was—before they could or wanted to address the discussion topic. The question about exams also illustrates a potential difficulty of international videoconferencing. The UMD students were referring to entrance exams to gain admission to their teacher preparation program; the Norwegian students thought they were asking about final exams for their courses. Each side came away with the idea that their peers have to take the kinds of exams they had in mind. Norwegian students, though, do not have to take similar kinds of entrance examinations and the UMD students do not take the kinds of comprehensive final course examinations (that can cover a whole year's content) that Norwegian students do.

For Fall Semester, 1997, we decided to return to try to deliver lectures via videoconferencing. One of our adjunct faculty members at UMD, who is the immediate past president of the Orton Dyslexia Society, had also had a Fulbright professorship in the Department of Education at NTNU six years earlier. We planned to have her present two lectures in NTNU's special education reading course, the course that she had taught when she was in Norway. Thus, she was familiar with the course's content, arrangements, and teaching methods as well as with the NTNU faculty currently teaching the course. She sent overhead transparencies and student handouts to illustrate her points through the mail ahead of time. Because of difficulties with the audio part of *CU-SeeMe*, despite many test sessions to adjust the program's various settings for transmission and reception, we used a telephone hook-up, with a headset for her and a speakerphone in Norway, for the audio part of the session. (The use of a separate system for the audio actually seemed to speed up the video transmission on *CU-SeeMe*.) The first lecture went very well. The lecturer verbally cued most of her overheads though a couple of times she had to hold them up to the camera to clarify, for example, which of the two possible matrices she wanted shown. She received a few questions and comments from the class in Norway, which provided for some interaction and discussion. The second lecture was not able to take place, however, as the Norwegians were unable, for some undetermined reason, to connect to the Internet that evening and it could not be rescheduled for a different date.

We also tried another discussion of a teaching case study. This time the participants were students in a behavior management course at UMD and, in Norway, Thygesen and a consultant at one of Norway's national centers on special education for students with emotional and behavioral disorders. Difficulties with the audio again affected the session. A telephone connection was used but, because there was no speaker phone available to the class in Minnesota, individuals had to take turns speaking into the phone, listening to the responses from Norway, and then providing a summary of the message to the rest of the class. Despite these limitations, the participants were able to identify many interesting similarities and differences between the American and Norwegian special education systems and societies.

Several sessions are planned for the rest of the school year. Staff from the above mentioned special education center in Norway will have a general discussion about special education with special education administrators from local school districts around UMD. A UMD professor who teaches the elementary education science methods course wants to have a Norwegian peer talk to his class about the ways science is taught in Norway. And students in masters-level special education seminars at UMD and NTNU will conduct several discussions on special education issues and their own research projects over the course of a term.

Summary

We have provided many details of the sessions as a way of illustrating some of the lessons we have learned. Technically, this approach to videoconferencing can be relatively inexpensive and easy to use; though its use benefits from technical support and back-up transmission systems. Logistically, differences in time, language, types of students, and instructional arrangements present time-

consuming problems, at least when initially developing plans for international sessions. Many of these difficulties have diminished, however, as our experiences with such sessions have increased. Educationally, the end results are worth all of the effort. The act of real-time communication with peers in another country, the exposure to new perspectives, the opportunity to expand institutional capacity and expertise, and the chance to develop relationships with others in the world are not as readily available through any other means.

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Stretching Computer Mediated Learning Environments across International Borders

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This paper discusses some of the theoretical and practical issues of extending computer mediated learning environments across cultural borders. While it will be of interest to any instructor whose courses entail a cultural dimension, the following discussion speaks to an audience who is familiar with the technical and educational implications of incorporating the use of computer mediated communication systems in course work. Its overall purpose is to convey to the reader the benefits of incorporating a computer mediated cross-cultural learning environment into a course whose content and objectives are conducive to such an activity. The criteria for successful applications are presented and issues relating to training and design are discussed.

Value of Extending the Classroom

The value of extending the university classroom beyond national boundaries is only one of the many reasons for increased intercultural communication relate to the growing internationalization of business (Adler, 1991; Brislin & Yoshida, 1994). The state of today's business world requires workers to interact with others from different cultural backgrounds, whether they are well prepared to do so or not (Manning, Curtis & McMillen, 1996). In the hope of building strong international working relationships between people and organizations of different cultures, it is important that students be prepared for the emerging future where cross-cultural communication skills will be of great importance.

A strong international work community is one where cultural identities are preserved while simultaneously transcended. That is to say that a healthy international work community does not eliminate diversity but rather welcomes other perspectives and seeks to understand all sides of every issue (Manning, Curtis, & McMillen, 1996). In order to meet the challenges of working in a global industry, tomorrow's worker must be able to view the world from a cultural perspective other than his/her own. This will require an understanding of the issues surrounding the diversity and tolerance of different points of views, work habits, communication patterns, social roles, and a myriad of other work-related issues. In short, the future workforce will have to possess a cross-cultural awareness of how individuals and groups of people vary from one another in terms of culturally based expectations, values and needs.

Powell (1997) defines cross-cultural awareness as a person's ability to:

- be sensitive to the existence and legitimacy of other cultures;
- understand and accept other cultures; and,
- view cultural phenomena from the perspective of the culture in which they occur, from the point of view of his/her own culture, and from that of others.

One way of developing these abilities is to present students with authentic opportunities to work with people of diverse backgrounds. By designing a computer mediated learning environment that stretches over different cultures, students can engage in activities that will promote an awareness of cultural differences.

Rationale for Using CMC

Computer mediated conferencing (CMC) does not, merely provide a different medium for traditional classroom interactions, but creates an environment for students to take part in much richer and relevant educational activities (Newman, 1990). By incorporating a computer mediated cross-cultural learning activity into the course curriculum, students are presented with new and greater challenges that extend beyond their traditional, and often passive, learning of theories and content.

With respect to building cultural awareness and tolerance, computer mediated cross-cultural learning activities have the potential of bringing about behavioural and attitudinal changes in people that otherwise would not occur. For example, business students may develop a deeper sensitivity for culturally based differences in work habits by interacting with students of diverse cultures

rather than reading about how one should be culturally aware of these differences in textbooks. Likewise, pre-service teachers may acquire a better understanding of culturally based differences in learning styles, knowledge representation and cognition if they are given the opportunity to interact with students from diverse cultures.

Perhaps more important, however, is providing students with the opportunity to participate in an authentic cross-cultural exchange releases them from the proverbial academic vacuum in which they typically build knowledge and understanding from readings and in-class discussions. Computer mediated communication technology has already changed the image of the classroom. What used to be thought of as a place confined by four walls is now perceived as part of a distributed learning system that is connected to world. The "new" classroom is connected to others by computer networks (Dyrli & Kinnaman, 1995; Kook, 1997). These networks stretch across international borders to form cross-cultural learning environments where teachers and students of diverse cultures can learn with and from each other. With its capability of bringing world views to the classroom instantaneously, CMC presents students with unprecedented opportunities to develop cultural awareness and build shared knowledge.

Other advantages of CMC are that, regardless of subject area, it introduces new opportunities for collaborative learning, facilitates individualized feedback as well as contact with peers and faculty, promotes reflective and critical thinking due to its asynchronous nature, and permits students to work at a time and pace that is convenient to them (Harasim, 1989; Boyd, 1990). McMahen and Dawson's (1995) recent review of the use of CMC in environmental education affirms that providing students with the opportunity to share data and discuss issues with others around the world increases motivation. Dyrli and Kinnaman (1996a) contend that CMC brings immediacy and individualization to the curriculum. In consideration of these benefits that CMC can bring to a learning environment, cross-cultural educational applications of computer mediated conferencing have the potential of being extremely useful and relevant to students' learning. Therefore, it is more than worthwhile to review current curriculum goals for real and potential computer mediated cross-cultural learning activities.

Preparing Students for Cross-cultural Learning Environments

A prime concern is that students be adequately trained to use the CMC system so that any anxieties or apprehensions about using the technology are overcome by the time the cross-cultural computer mediated learning activity begins. This entails building sufficient practice time into the course curriculum. A number of studies conclude that giving students the time and freedom to explore the new technology reduces anxiety and enhances performance (O'Malley, 1995; Kolodner & Guzdial, 1996). Therefore, CMC training should be designed to meet the specific needs and ability of the using group (McMahen & Dawson, 1995) and be fully integrated into the course so that students can hone the technological skills they require to contribute to a cross-cultural learning environment.

In addition to acquiring the technological skills and course content required to participate in an international forum, students should be specifically trained on the issue of cultural diversity. This type of training should introduce an awareness that there is a major influence called *culture*, that it has major effects on people's lives, and that different behaviours are considered culturally appropriate/inappropriate in different parts of the world. It should also cover the knowledge necessary to work and learn in other cultures, that is, the knowledge, broadly defined, that is considered important in other cultures.

Preparing Faculty for Cross-cultural Learning Environments

In their new roles as facilitators of learning, instructors are charged with the design, implementation and maintenance of purposeful and productive virtual learning environments (Kook, 1997). In the best of situations, instructors can design and facilitate a computer mediated environment conducive to collaborative learning (Ahern, Peck, & Laycock, 1992). However, the CMC literature indicates that learning through computer mediated systems requires skills not commonly found among faculty of higher education institutions (Ahern, Peck, & Laycock, 1992; Bailey & Cotlar, 1994). Creating and participating in an online community of learners are new strategies for some instructors. Therefore, to ensure the success of a computer mediated cross-cultural learning activity, faculty must develop competencies in the following areas:

General Uses of CMC in Education

Using the CMC system. Instructors, like their students, need to feel comfortable and confident with the technology prior to implementing an elaborate application. Hiltz (1986) estimates that an instructor requires between 30-50 hours of online practice time to sufficiently learn computerized conferencing. Hiltz recommends that instructors master their CMC skills experientially, that is, by incorporating the use of CMC learning activities in a course, beginning with small, easy-to-manage projects first.

Accepting New Responsibilities. In a computer mediated learning environment, the structure of the teaching changes. Rather than being the source of information, the instructor assumes the role of facilitator, releasing control of learning to the students (Shedletsky, 1997; Knupfer, 1993). In a computer mediated learning environment, there is great potential for students and teachers to learn together and to learn by discovery. Faculty training must therefore include helping instructors to feel secure

about their new role and to become comfortable with the idea that it is the learning community, not the authority, which is well represented in CMC (Shedletsky, 1997) and that this mindset naturally extends to computer mediated cross-cultural learning environments.

Facilitating the Learning Activity. It is the instructor's responsibility to guide the online activity so that its learning objectives are attained. Facilitating online is synonymous to moderating, which entails the instructor's ability to organize and manage the virtual space, ask and answer questions, provide feedback, direct discussion, and encourage cooperative and collaborative learning (Kook, 1997).

Related to Cross-cultural Applications of CMC

Cross-cultural Awareness. In order to properly design and implement a cross-cultural activity that will encourage and promote academic achievement, instructors must believe in cultural differences and similarities, believe in the uniqueness of people, and hold the opinion that cultures are neither superior nor inferior to one another (Powell, 1997).

Identifying Learning Styles. Researchers suggest that individuals tend to fall into distinct categories with regard to the manner in which they prefer to learn and, to a large degree, that these preferences are culturally determined (Adler, 1991; Brislin & Yoshida, 1994; Sheffield, 1997). Differences in learning styles must, therefore, be taken into consideration when designing the computer mediated learning environment and cognitive activity.

Finding Common Ground. It is important to identify common ground without diminishing the importance of cultural differences. Both cultural-general and cultural-specific approaches to designing the virtual space and learning activity should be considered (Brislin & Yoshida, 1994). At the university level, the literature (i.e., assigned readings) may easily serve as the common ground.

Resolving Communication Issues. Verbal and nonverbal messages have significant impact on teaching and learning processes (Brislin & Yoshida, 1994). Research carried out by Hiltz (1995) suggests that failure in computer mediated learning environments occurs far more often on the social level, rather than the technical level. Critical to the development of any educational relationship is the degree to which trust and mutual understanding emerge (Boyd, 1990). As a result of the extent to which differences in language and communication styles can result in significant misunderstandings or misjudgments about the motivations of others, instructors must be able to help students transcend communication problems.

Designing the Virtual Learning Environment

The very first step in designing a successful computer mediated cross-cultural learning environment is to analyze learner characteristics and then, based on this analysis, select activities that encourage and support the academic achievement of all students participating in the international forum (Sheffield, 1997; Powell, 1997). More precisely, instructors must determine how the needs of students with culturally based differences in learning styles, cognitive orientations and motivational cues can be met. By identifying the commonalities and differences, instructors can design learning activities that recognize and celebrate cultural diversity. A challenging learning activity would deal with issues common to diverse cultures, yet show variations significant enough for analysis and discussion (McMahen & Dawson, 1995).

With regard to the issue of motivation, Romiszowski and de Haas (1989) report on difficulties they encountered in motivating students to participate in a computer mediated activity. The design of the virtual learning environment is a critical factor in motivating students to participate. The computer mediated cross-cultural learning environment should be structured (i.e., in terms of navigability, pace of learning, type of learning activity, types of assignments) such that students want to enter, contribute and belong. According to Hiltz (1995), the most successful computer mediated learning environments are those designed to encourage participation, collaboration, critical thinking and knowledge building. Therefore, it would be worthwhile to include these same social and cognitive activities in computer mediated learning environments that stretch across international borders.

Finally, a number of scholars contend that CMC learning activities meet with more success if they are integrated into the course rather than remaining an appendage (Bailey & Cotlar, 1994; Bork, 1993; Romiszowski & de Haas, 1989). The same principle applies to learning activities designed to promote cross-cultural collaboration. Group work, for example, could be carried out in a cross-cultural computer mediated environment provided that its purpose is useful and relevant to the students' learning of course content. To ensure that the learning activity is consistent with, and applicable to, other elements in the course, design issues relating to the planning and coordinating of both its online and off-line components should be addressed. It is crucial that students have activity-related off-line work to engage in while they wait for responses or when technical difficulties interrupt communication.

Implementing Computer Mediated Cross-cultural Learning Activities

The point of incorporating CMC activities into the curriculum is to present students with unique learning experiences to which they wouldn't normally be exposed (Dyrli & Kinnaman, 1996b). Stretching a computer mediated learning environment over international borders, for example, provides students with the opportunity to learn with and from students of different cultures. Recent

work by Dyrli and Kinnaman (1996b) confirm that learning activities that require collaboration among students in different countries are among the richest offerings an instructor can present to his/her students. Such activities are often organized around analyses and discussions of "real-world" problems or issues (McMahen & Dawson, 1995) that are relevant and important to culturally diverse groups of students. Trying to resolve the issues, or at least coming to an agreement about possible solutions to the problems, not only increases students' knowledge of the content area but heightens their cultural awareness.

The first step in implementing any kind of computer mediated cross-cultural learning environment is to connect with instructors teaching a similar course in another country (i.e., similar content and objectives). A comparative education course, for example, would be well suited to a cross-cultural exchange of ideas because i course objectives are to contrast educational systems and practices in Western nations with developing nations. Other content area suited to cross-cultural discussion include, but are not limited to, international business, education studies, educational technology, teacher training, sociology, environmental studies, science and engineering. Once contact has been made, the collaborating instructors can begin to plan and design their learning environments and activities.

While computer mediated cross-cultural learning environments may vary according to content area and learning objectives, Dyrli and Kinnaman (1996b) point out that some fundamental elements of incorporating this type of application into the curriculum transcend all subject matter. A list of criteria for implementing successful computer mediated cross-cultural learning activities is presented below.

- The activity must be relevant to the course and integrated into the curriculum goals.
- The activity's learning objectives must be clearly stated so that instructors and teachers from all cultural backgrounds understand its purpose.
- The activity should be important and relevant to culturally diverse groups of students in order to sustain learner interest, motivation and participation.
- The activity must include some aspect of work or learning that could not be accomplished without cross-cultural computer mediation. Student interest in, and commitment to, the virtual learning environment may diminish if they perceive that the learning activities could be done just as easily, if not better, outside of the international forum. It is crucial that the cross-cultural activity contain a unique element or dimension that otherwise would not be present.
- The activity should have a clear and definite time-frame. Students aware of the time-frame within which they are working may be more inclined to adopt proactive writing habits so that the virtual learning environment isn't deteriorated by prolonged inactivity.
- The activity should begin as simply and uncluttered as possible. Overly complex activities may lead to information overload resulting in frustration, loss of interest and inactivity.
- The activity should be preceded with greetings and introductions. Students should be given the opportunity to "meet" online before engaging in the structured learning activity.
- The activity should encourage information sharing and knowledge building. One of the greatest potentials of a computer mediated cross-cultural exchange is to overcome the barriers that restrict the flow of ideas and the sharing of knowledge.
- The activity should not compromise the learning quality. Although it may provide new and innovative learning opportunities, the academic standards and levels of achievement must not be compromised.

Grading should take both online and off-line CMC efforts into account. Not to recognize and evaluate both types of work would be to ignore the vital impact that the CMC learning activity has within the classroom.

Types of computer mediated cross-cultural learning activities include, but are not limited to, debates; collaborative writing projects; concept mapping; posting summaries of readings; group discussions; question & answer forums; building shared databases and inter-bibliographies. With respect to learning tasks, online activities range from low-level cognitive tasks, such as brainstorming and idea generation (Hollingshead & McGrath, 1994), planning, collecting, organizing, and pooling information for a common purpose (Dyrli & Kinnaman, 1996b), to high-level cognitive tasks which include problem solving and conflict resolution (Hollingshead & McGrath,1994). Regardless of the cognitive level of the learning tasks, they should always be relevant to curriculum goals and appropriate for the specific cultural groups of students to whom they are being assigned.

Conclusion

In this era of effective and reliable electronic means of communication, planned or intentional learning activities should no longer be confined to the classroom. Students' learning environments are expanding beyond physical and cultural borders and faculty must acquire the competencies required to help students take advantage of the new and challenging learning opportunities with which they are being presented. As is suggested in this paper, computer mediated exchanges between students of different cultures

is an innovative and purposeful way to make use of the technological and social resources readily available in the university milieu.

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Using Multimedia/Hypermedia Projects to Integrate Global Themes in a Teacher Education Technology Course

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Recognizing the need for a college education with a strong global perspective, Missouri Southern State College recently enhanced its educational mission to expand an existing international emphasis. The institution supports activities it deems necessary and appropriate to establish international or global education as a distinctive theme of its mission. One such activity is curriculum revision to include a global perspective in every possible course. For example, the fall 1997 semester has been designated as the "China Semester". The spring 1997 semester saw numerous speakers, activities and events offered to faculty and students in preparation for the "China Semester". Faculty were encouraged, but not required to integrate this theme into activities for the semester.

Teacher Education Technology Course

All elementary and secondary teacher education majors are required to take a technology course offered within the Teacher Education Department. This course includes such topics as: the changing role of the teacher; activity-based approaches to learning; cognitive learning and technology tools; instructional software; constructivism and project-based learning; using tool applications; multimedia/hypermedia applications; creating multimedia projects; working with images and sound; and principles of hypermedia design. One of the projects required of students completing this course is the creation of a collaborative hypermedia/multimedia project. This project must be thematic in nature and give evidence of mastery of certain technical skills including image scanning, video capture and editing, audio capture and CD-ROM mastering. Completed projects are then converted to Web pages and published on the college's internal home page.

Integration of Global Theme

Integrating the China theme with the required multimedia projects, Education 301 students (teacher candidates) enrolled in the fall 1997 semester created products to be used in multidisciplinary thematic units with students at the K-12 level. Teacher candidates were assigned to groups of like-teaching levels to complete the projects. For example, early childhood teacher candidates worked together to design and create multimedia projects to be integrated into a China or global thematic unit. Likewise, secondary education majors from a variety of disciplines collaborated in creating a similar project. To meet the course requirements for the project, it had to be interactive and student-controlled by design.

Design Process

Students brainstormed in their assigned groups to choose a theme related to China to develop for the multimedia project. After this initial decision was made, many groups used webbing or similar techniques to select clusters of ideas to use as topics within the theme. Content to support each cluster, as well as resources for this information was then selected. For outside resources, permission for use requests were written. Students were also locating sources for proper citing of these references. At this point, most groups decided to assign topics to each group member for research extending beyond class time. In-class time was primarily utilized developing a storyboard for the project, creating a color scheme, and then subsequently creating slides complete with hyperlinks to serve as the backbone for the project. Once this was accomplished, students began entering text on slides, leaving placeholders for future insertion of images, video and audio clips. Classroom demonstrations and practice sessions were given for students to master recording and storing audio clips from microphone and CD. The more complex process of video capture techniques occupied much more time. Students worked with the instructor in small groups to accomplish this task. Throughout these stages of development, on-going editing occurred and revisions were being made. Students discovered that initial topics were too broad or too narrow in scope to develop properly in a multimedia format. When the initial topic

had been too narrowly defined, students were required to develop additional supporting nodes to develop in their storyboard. In the case of topics being too broad, the groups would simply leave some nodes for future development or projects and focus on limited clusters or nodes for the immediate project development.

Hardware and Software for Project

Class size for this course is limited to sixteen students due to the number of computers in the Education technology labs. At the time this project was first implemented, there were two labs available to students in the Education building and numerous labs across campus. The labs were equipped with twenty-three Windows-95 based, networked computers with Internet access. Eight of these were multimedia equipped; all had hard drives. In addition, there was one mobile multimedia system equipped with a video capture card, ZIP drive, and CD-R drive. Two of the systems in the labs had flatbed, color scanners, and three had ZIP drives.

Initial plans were to utilize *Astound* multimedia authoring software. Due to the time pressures inherent in such a technology course, Microsoft *PowerPoint 97* was selected for use since students utilized it earlier in the semester to create an electronic slide show. This version of *PowerPoint* had incorporated hyperlink features not found in previous versions, which allowed a non-linear product to be created. One of the drawbacks of using this software included the absence of a tool to create scrollable text boxes, such as those found in *Astound*. In future semesters, *Astound* software will probably be used for just that reason. This will require streamlining the course in other areas to free-up additional time resources to learn another software program. At the time, the reduced learning curve of using *PowerPoint* offered too great an advantage to ignore.

Projects were stored on the hard drives of the networked workstations, with backup copies stored on the server hard drive. Zip drives were used for transporting video clips from the machine with the video capture card to individual workstations and also, for carrying the finished project to the computer housing the CD-R drive for final storage on a CD. Students designed their own CD labels for each finished product.

Project Assessment

Two instruments were used for assessment of the final project. An assessment rubric was created for evaluating the quality of the student project. Because this was a group project, there had to be some means of determining the extent of involvement, participation and contribution of individual group members. For that aspect of evaluation, each group member completed a peer evaluation form to assess the individual group member's performance as part of the team. This factor was then applied to the overall evaluation derived from the rubric to attain a final individual grade for each student. In addition, many of the skills utilized in creating this project were assessed individually in a hands-on skill test administered during the final exam session.

Problems Encountered and Future Considerations

Limited access to specialized equipment such as scanners, video capture cards, sound cards and microphones restricted the level of development reflected in the student projects. Eight multimedia systems equipped with internal Zip drives, an additional CD-R drive and video capture card were planned for expansion at the time of this writing. The course will be modified to allow students to acquire enabling multimedia related skills earlier in the semester.

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MATHEMATICS

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In our attempts to include technology in mathematics teacher education there are several concerns which must be addressed: What needs to take place and why?; How can set up an infrastructure supporting the change?; and, What would programs implementing such changes look like? In addition to describing some fascinating programs and approaches, the papers in this years mathematics section can be loosely categorized as falling into these three areas. Although we recognize that there are many other themes present in the papers presented before you, we hope that you will find this loose organization and these themes helpful in your reading and analysis.

What needs to take place and why?

In addressing this first question, it is helpful to begin by examining current thinking in the mathematics reform movement for guidance. Naturally there are many aspects of the mathematics reform effort, and not all of them lend themselves to immediate support by technology. This is to be expected, and we should not fall into the trap of forcing an answer on an unasked question. I am sure we have all heard that when you only have a hammer, the entire world looks like a nail.

Mathematics education, however, has many areas which are supported by technology and the reforms suggested are no exception. Two current foci of the reform effort come forward which could both be highly supported by technology: the increasing importance of "Function" as a unifying concept, and the ongoing inclusion of Algebra and algebraic thinking throughout the entire K-12 curriculum.

Function is rapidly becoming one of the organizing concepts within mathematics education. The day is long past when mere mathematical computation is adequate. We do not need students who can follow functions, we need students who can create new functions which adequately represent the mathematical situation of hand. In addition to it's mathematical power, the notion of function is uniquely suited for teaching and learning with technology. With algebra assuming a greater importance over time, and technology taking over more and more mundane number crunching details of mathematics, it is perhaps this area - the creation and editing of functions to fit problem situations, where students have their greatest opportunity to experience what it is to think mathematically.

In Pullano's paper and associated website we see a marvelous response to this identified need. As research has documented numerous learning difficulties associated with acquiring functional concepts, this paper presents and discusses some of these - including several studies where technology was used to enhance the mathematics classrooms. The WebSite, designed by the author, is valuable if or no other purpose than serving as a reference for the field. You will want to bookmark this location at your earliest opportunity.

In dealing with the importance of function within the mathematics community Telese describes a staff development program for middle and high school teachers. This program was designed to improve teachers understanding of mathematics and foster specific techniques for improving mathematics performance. Within his project we see the development of powerful representations for functions using symbolic and graphical representation. The use of information technology within this approach is quite natural, with graphing technology used to enhance students understandings of the function concept. As we later shift to thinking about methods and policies it will doe us well to remember his approach. The technology is transparent and does not drive the program, rather, it serves as a natural tool and enhancement for the teachers and students to use - or not use - as appropriate.

The theme of utilizing technology to promote functional development and algebraic awareness is further developed in the paper by Abramovich and Brantlinger. As they point out, the nature of the tools which one has to think with influences those questions which one may think about.

Taking this is starting point they suggest ideas using spreadsheet based toolkit and provide concrete examples in exploring infinite processes through simple alter great word problems. By taking example problems firmly rooted within the NCTM standards they argue, quite successfully, that the spreadsheet can help teachers enable students to make connections between their ideas in their representations. In particular, the multiple representations presented in the spreadsheet enable changes in student viewpoint and thinking about the problem. In this work the spreadsheet becomes a true cognitive tool enhancing the students abilities to think, represent the problem in new and novel ways, and create new representations for further use.

Technology as a means of thinking about algebraic concepts also form the framework of Zehavi's paper. As this paper correctly notes, despite the growing power of symbolic and numeric calculations enabled by the computer, many secondary teachers remain unaware of the degree to which such systems can be effective in teaching algebra. Software has long since evolved to the point where what is technically feasible is ahead of what is currently being done in the mathematics classroom. This paper reports efforts of a professional development course designed to help teachers use powerful new programs in algebra. The teachers quickly assumed ownership of the program and began using it is a natural extension of their own thinking style. In the examples, there are some classical problems used to show how teachers were thinking about their technology, the mathematics, and degree to which tools work together well.

Lee and St. John's paper provides some quantitative backing to Zehavi's position regarding the relatively low level of use of technology in secondary mathematics. Their study presents results from a survey of 800 seondary mathematics chairs who were questioned regarding their use of computing technology in mathematics instruction - particularly in the areas of probability and statistics. In addition to pointing to the perennial need for additional hardware and software, this study clearly shows that we need to make great strides in improving our integration between technology and the teaching courses themselves. They also note that if one expands the definition of instructional technology to include graphing calculators the useage picture becomes much brighter. This is an exciting as well as daunting prospect, for as the current proliferation of palmtop computers shows, we are in a situation were the gap between the computer and calculator is narrowing on a daily basis. We will soon no longer be able to rest upon the excuses we do not have the equipment, but instead must deal with doing a better job in preparing our future teacher educators.

Lest one get the idea that technology is only suited for the secondary level, we see described in Spikell, Behrouz, Bannan-Ritland, and Egerton's paper a truly marvelous website geared for the 4th through the 8th grades which presents a set of virtual manipulatives for student use. The authentic tasks which are presented here take advantage of traditional math manipulatives and are presented in realistic situations. Students are able to draw upon these resources in combinations and fashions which would not be possible within their classroom using traditional manipulatives.

How can set up an infrastructure supporting the change?

Whenever change is made there needs to be changes in the support systems if that change is to be maintained. Sometimes this involves policy considerations, changes in resources, and careful analysis of the desired directions and outcomes of a program. The papers within this subsection address these and more.

We choose to begin this section with Garofalo, Shockey, and Drier's guidelines for developing mathematical activities incorporating technology. This paper provides some common sense, timely, and easy to follow guidelines which are a must read for the technology using mathematics educator. These guidelines have both policy and instructional implications. They should certainly be taken into account when planning beginning efforts in introducing technology into the mathematics classroom and in evaluating existing programs.

Continuing with this evaluative emphasis, Coe's paper gives us a set of workable screens through which to examine mathematics education websites. Her key questions of accessibility, accuracy, authority, content, etc., should be addressed in any well-designed WebSite. This paper provides valuable insight in terms of some worthwhile and global investigations and evaluations of existing WebSite's and presents a very manageable approach. As this paper appears to have been designed as a companion to her presentation it would be well worthwhile to attend this session if at all possible.

Of course, bringing new methods requires new approaches - and these should be carefully studied from both policy and logistical perspectives. In Miles-Grant's paper we see a careful and thoughtful analysis of a three-year intervention including summer workshops, follow-up classroom visits and consultations, focus group meetings, consultation, and email together with professionals from a variety of levels. In addition to its rich descriptions, another finding which this paper serves to illustrate is the power of the data to function approach. If we're to be effective in mathematics is developing function as a primary concept, as we suggest in the earlier subsection, a source of data from which functions are to be created is of crucial importance. As this paper serves to illustrate when teachers are presented with real data, the solutions are not only more personally meaningful but the functions which are derive from his data are more mathematically relevant as well as

powerful. A careful review of this paper would be beneficial for any planning similar multi-year projects.

In thinking about setting up support systems it is highly important not to leave our the needs of the individual. In Charles' paper we see a qualitative case steady examining how one teacher used the interactive development program, "Understanding Teaching", to learn and apply the professional standards for teaching mathematics. Results from this steady indicate that she improved her ability to correctly identifying strands from the NCTM Standards and was successful in incorporating new questioning strategies into her practice. This case study shows how one can become a better mathematics teacher in light of the NCTM standards. Charles notes that "Understanding Teaching" has been the subject of several previous studies indicating its effectiveness. We recommend a careful reading of this paper for those unfamiliar with the program.

In the last paper within this subsection, Davis provides us with a model for addressing teacher change which is worthy of reflection and possible use in planning research, policy, and implementation. Although one may disagree with certain features of this model it does lend itself towards the creation of testable experimental hypotheses, which can serve as the foundation for further research. For example, just because we describe in policy papers the need to better integrate technology into mathematics classrooms, that alone is gaurantee that this will occur. This certainly plays often mathematics education. Despite problem sea of large numbers of policy documents requesting technology to be used as a tool in the mathematics classroom, we still see a predominant use of drill and practice technology. The research presented in this paper is a case study focusing upon the experience of one teacher using technology in mathematics instruction.

What would programs implementing such changes look like?

In actual implementation we find that there are many different features of the suggested and supported change which can be implemented. As each institution will bring their own spin to this, it is interesting to see the unique features of each of the programs described within this subsection. As might be expected, many of these approaches are still "under construction", different, and exciting.

We will begin with Bruillard and Baron's case study describing a novel treatment of video clips wherein the teacher candidate created the material for study. Starting with over 2 1/2 hours of classroom instruction which had been digitized into QuickTime format over 100 short fragments between 10 and 25 seconds each were identified, typed, and indexed. These video fragments were then used by preservice teachers as a part of their teacher training. This exercise helped the teacher candidates in identifying the logic behind teacher actions and to further develop their skills using image processing software.

In what the authors identify as a "lets have our cake and eat it too" mode we will next look at Connell, Kemper, White, and Williams discussions of their attempts to integrate technology, methods content, and field basing. This paper describes a transdisciplinary course within which the mathematics, social studies, science, and language arts areas were taught in a field based collaborative fashion. From this work several suggestions may be made for others. Start with people you like, and try to find some unifying philosophical themes around which you have agreement. Once this is done, technology can provide a set of transdisciplinary "soft" tools supporting the transdisciplinary methods being developed.

The final paper in this subsection provides a powerful policy analysis of the curriculum in England and Wales as well as a thorough description of one institutions responses to the changes in policy. Miller and Denning begin by providing a historical background concerning the state of mathematics and technology within England in Wales which is a must read for those unfamiliar with this system. The described Keele University's model for the use of instructional technology in math education grew out of a four-year series of efforts. It includes several novel features such as integration of notebook computers, a broad variety of Web based resources, and calculators.

Concluding Thoughts

And what if you are satisfied with the status quo? Then write about it and share it with SITE next year! We look forward to seeing you at the conference and in further discussing these, and other themes, with you.

The Teaching and Learning of Functions: A Website

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One of the most important, if not the most important, unifying ideas throughout all areas of mathematics is that of functions (Dreyfus & Eisenberg, 1983; Eisenberg, 1991). From the day elementary students begin constructing algorithms for addition and subtraction, through graduate level mathematics courses, function ideas saturate the curriculum. Functions have "become one of the fundamental ideas of modern mathematics, permeating virtually all the areas of the subject. Yet...it proves to be one of the most difficult concepts to master" (Eisenberg, 1991, p. 140).

The importance of function within mathematics curricula has been echoed in recent reform documents. For grades 9-12, the Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics [NCTM], 1989) Standard 6: Functions states:

In grades 9-12, the mathematics curriculum should include the continued study of functions so that all students can-

- model real-world phenomena with a variety of functions;
- represent and analyze relationships using tables, verbal rule, equations and graphs
- translate among tabular, symbolic, and graphical representations of functions;
- recognize that a variety of problem situations can be modeled by the same type of function;
- analyze the effects of parameter changes on the graphs of functions; and so that, in addition, college-intending students can-
- understand operations on, and the general properties and behaviors of, classes of functions (p.154).

In addition, Standard 8: Patterns and Functions for Grades 5-8 contains the following:

In grades 5-8, the mathematics curriculum should include exploration of patterns and functions so that students can

- describe, extend, analyze, and create a wide variety of patterns;
- describe and represent relationships with tables, graphs, and rules;
- analyze functional relationships to explain how a change in one quantity results in a change in another;
- use patterns and functions to represent and solve problems (p.98).

Finally, the Standards call for a movement away from rote "memorization of isolated facts and procedures and by proficiency with pencil and paper skills" to the emphasis of "conceptual understandings, multiple representations and connections, mathematical modeling and mathematical problem solving." To make this possible, one underlying assumption made by NCTM for grades 9-12 is that all students will have access to graphing calculators (p. 124).

On the whole, the Standards advocate the use of multiple representations when exploring functions, connections to meaningful problem situations, understanding relationships among classes and families of functions, the incorporation of graphing technology into the mathematics classroom, as well as emphasizing the role of variable within functions. These goals evolved directly from the existing body of research on the teaching and learning of functions.

The remainder of this paper is divided in to three sections. In the first section, several of these difficulties as reported in the literature will be explained. The second section will focus on literature reporting on the use of graphing utilities when teaching function concepts. The third section contains a description of a website developed by this author consisting of a reference list of function literature, synopses of this literature, and classroom activities based on the research findings.

Functions and Associated Learning Difficulties

There exists a vast body of research which examines difficulties students have when learning and working with functional concepts. Such difficulties include an inability to correctly interpret graphical representations of data (Monk, 1992), compartmentalization (Vinner & Dreyfus, 1989) a reluctance to use visualization and visual techniques to solve problems (Eisenberg & Dreyfus, 1991), the inability to make connections among the multiple representations of functions (Movshovitz-Hadar, 1993), conflicts between the formal concept definition of function and students' concept image of function (Vinner, 1992) and scaling, notational, and representational difficulties (Goldenberg, 1988).

Difficulties students have interpreting graphs displaying either qualitative or quantitative data are numerous. One manifestation of such difficulties has come to be known as iconic translation. Iconic translation can be thought of as the literal interpretation of information represented graphically. For example, a student might interpret the distance vs. time graph for a cyclist shown below as the cyclist riding uphill.

Figure 1. Distance vs. Time Graph for a Cyclist.

Compartmentalization is the inability to apply knowledge acquired in a prior context to a new context. Often, a student is unaware that s/he possesses knowledge which would be relevant to the current context. This may lead to inefficient problem solving behavior or worse, total failure. Vinner & Dreyfus (1989), examined compartmentalization by compiling all cases in which students gave the Dirichlet-Bourbaki definition for function but failed to use that definition when answering the researchers questions. The researchers found students enrolled in higher level mathematics courses exhibited fewer instances of compartmentalization quite possibly because they were more aware of their thought processes.

Eisenberg & Dreyfus (1991) discussed several reasons why students avoid the use of visualization when completing mathematical tasks. These included commonly held beliefs that mathematics is inherently nonvisual (proofs without words are generally not accepted as true proofs), a sociologically based rational called didactical transposition (school mathematics is severely linearized, compartmentalized, and algorithmetized and hence is more efficiently presented to students in a nonvisual manner), and that cognitively, visual arguments can be more difficult to understand requiring skills which are underdeveloped in most students.

There exists a general consensus among mathematics educators and researchers that many students fail to build conceptual bridges among multiple representations of functions. The failure of students to understand that the roots of a quadratic function found algebraically are represented graphically by the x-intercepts of a parabola is one such example. It is important that students understand how different presentations of a function stress and reveal different aspects of the function while fostering connections among representations.

Frequently, students are unable to connect their personal concept images of function to the textbook definition of function. When facing problem situations, students often make use of their concept image of function while ignoring the concept definition. Concept images are constructed as a result of everyday experiences and include examples, non-examples, theorems, and all the facts they know about the particular concept, in this case functions. Many times, concept images and concept definitions differ greatly. This disparity may result in a student's concept image distorting his/her concept definition (Vinner, 1992).

The reasons for the difficulties listed above are myriad. Perhaps the most compelling of these is the traditional point of entry used to introduce functions. Traditional instruction of functions begins with the presentation of a textbook definition such as "a function is a relation that assigns to each element of a set X exactly one element of set Y" (Lial, Miller, & Schneider, 1990). Such a definition is structural in nature referring to sets and elements of these sets as objects.

A second method for explaining the concept of function is the use of a diagrams similar to the one below.

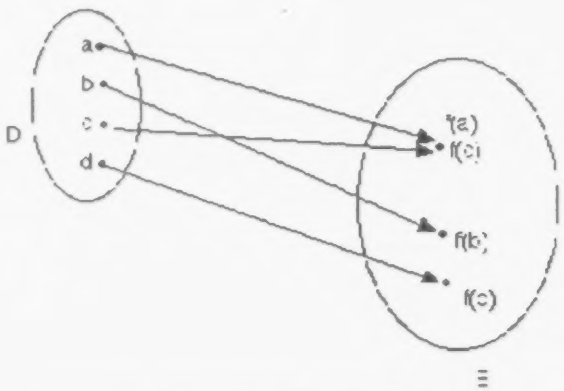

Figure 2. Function defined as a Mapping.

These diagrams are also structural in nature and regularly appear in texts of all levels. There is no mention of the process or processes involved which determine the mapping.

Most often, the teaching of functions continues by presenting students with algebraic expressions. Students are asked to generate a set of ordered pairs, plot these points, and construct a graph. This approach has numerous shortcomings. It is time and labor intensive, it discourages

the exploration of real world functions, and it shifts the focus away from understanding and interpretation to graph construction - a task easily handled by graphing calculators. This method may also encourage the development misconceptions such as students coming to view graphs of functions as a set of discrete points and not as continuous entities (Kerslake, 1981).

Research Findings

Processes and patterns make up the operational aspects of functional conceptions and must be investigated before the learner can move to the more abstract notions of functions as objects. Technologies of today, such as graphing calculators and micro-computers, make investigations of this sort readily accessible to students and teachers alike.

Ayers, Davis, Dubinsky, & Lewin (1988) incorporated instructional interventions consisting of both directed and nondirected instructional experiences using a modified Unix operating system. Posttest results suggested that students exposed to these types of interventions were better able to construct the concepts of function and composition through reflective abstraction. Student responses to specific posttest questions led the researchers to conclude that experimental groups were "better at interiorizing the processes of functions and forming mental representations," "more likely to encapsulate a function as a cognitive object," and more able to generalize "the concept of function beyond algebraic formulas" (p. 257).

Ruthven (1990) reported on the performance of upper secondary school students tested on symbolization items and interpretation items. Test results of students using graphing calculators regularly were compared to results of students who did not have regular access to such technology. This comparison suggested that regular use of graphing calculators fostered more frequent uses of graphical approaches to problem solving.

Mokros & Tinker (1987) observed groups of students using Microcomputer-Based Labs (MBL) with motion detectors. A posttest was also administered. The observations focused on how students developed graphing skills through the use of such equipment. Posttest scores indicated significant changes in students' ability to correctly interpret and use graphs. For example, instances of iconic translation occurred substantially less frequently. MBL use of multiple modalities, their ability to produce real time graphs, and the ability to incorporate meaningful scientific experiments into the mathematics curriculum made them powerful teaching tools. Furthermore, MBL eliminate the need for labor intensive graph production freeing time for more "what if" and "why" explorations.

Yerushalmy (1991) examined how a multi-representational computer environment effected students' conception of when being introduced to algebraic functions for the first time. The software Function ANALYZER was the main tool used in this study. The students in this study spent less time on traditional graphing drill and practice experiences and more time observing the multiple representations of functions. Results showed however, that these students did not lack the skills need to solve traditional graphing problems. In fact, students were frequently more capable of matching a linear graph with its equation regardless of the imposition of scales on the graphs designed to mislead. These results support "the use of new learning environments as teaching aids for the changing of priorities in the learning and teaching of algebra, as well as the revision of the traditional curriculum so that more emphasis would be placed on the inquiry into functions within linked multiple representations environments" (p. 55).

The Website

The above pages include many references to literature in the area of the teaching and learning of functions. In an effort to provide educators with an easily accessible and somewhat comprehensive listing of this literature, this author has created The Teaching and Learning of Functions: A Collection of Research Findings and Classroom Activities website. The website can be found at http://curry.edschool.virginia.edu/~fbp2r/function.

This website is comprised of two main sections. The first section contains a listing of almost eighty references of function literature in APA form. Visitors may choose to view the references in one of three ways - alphabetized as an entire list, alphabetized by author's last name, or alphabetized by one of five categories. The categories include Literature Presenting Analyses of Understanding of Functional Concepts, Studies on the Understanding of Functional Concepts, Literature Supporting the Use of Technology, Studies Incorporating the Use of Technology, and Reviews of Function Literature, Each reference listed is linked to a synopsis of that reference.

The second section contains several function related activities which teachers may use in their classrooms. Some of these activities have been adapted from the literature on functions while others are original works developed by this author. All of the activities are designed to address the learning difficulties discussed in this paper. Some of the activities suggest alternative methods to the introduction of functional concepts. Others explore functional concepts within meaningful contexts including business applications and projectile motion. All of the activities incorporate the use of graphing calculators although other graphing utilities may be used. It is hoped that students, as well as teachers, will enjoy these activities and develop a more complete concept of function given the opportunity to work through them.

Summary

Leinhardt, Zaslavsky, & Stein (1990) point out that functions and graphs represent "one of the earliest points in mathematics at which a student uses one symbolic system to expand and understand another (e.g., algebraic functions and their graphs, data patterns and their graphs, etc.)" (p.2). The authors also believe that graphing is a critical moment in early mathematics, i.e. it is a site "within a discipline when the opportunity for powerful learning - different in kind from other episodes - may take place" (p. 2). A clear understanding of functional concepts provides a gateway for students to study higher level mathematics. It is imperative that mathematics educators realize this importance by incorporating sound instructional practices which make use of available technologies into their teaching methods.

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Learning of Function Concepts through Graphing Technology and Problem-based Learning

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Algebraic knowledge is considered a requirement for a new literacy. The point is made by Schoenfeld (1995) who stated: With too few exceptions, students who do not study algebra are therefore relegated to menial jobs and are unable often to undertake training programs for jobs in which they might be interested. They are sorted out of the opportunities to be productive citizens in our society (p. 11-12). Moreover, algebra is a mathematics class that has been described as the "new civil right" (Moses, 1995). The view of algebraic knowledge as a "civil right" implies that this knowledge should be made accessible to all students. Algebra I is the first non arithmetic class encountered by both high school and some middle school students. If students are not successful at this stage, then students may not be able to take advantage of this "new civil right." Now that algebraic knowledge is considered a contributing factor toward success in life by the mathematics education community, it becomes necessary to provide learning opportunities that have the best chance to engage students' interests while improving their understanding of algebraic concepts.

The purposes of this paper is to report on a staff development program for middle and high school teachers, and to introduce a process model used for mathematical modeling. The goals of the program is two-fold: i) to improve the teachers' understanding of mathematics, and ii) foster the development of techniques for improving the mathematics performance of culturally diverse students.

Theoretical Background

According to Schwartz (1992), the content of secondary school mathematics should be "made coherent and pedagogically workable" (p. 303). The coherence of algebra curriculum can be achieved through a central concept, such as functions which has been considered a unifying topic in both algebra and other secondary school mathematics courses. Mathematics educators (e.g., Bednarz, Keiran, & Lee, 1996; Romberg, Fennema, & Carpenter, 1993) have issued a call to center algebraic teaching around both problem solving and the function concept. Algebra can be made "pedagogically workable" through appropriate use of problem solving activities designed to enhance students' understanding of concepts related to functions, such as variables, linear and quadratic equations. The algebra curriculum centered around functions and problem solving offers students an opportunity to take advantage of their "new civil right."

The notion of function should be expanded from its view of an abstract object to an understanding that functions describe real-world phenomena. Families of functions, such as linear, exponential, and rational, are reasonable models to study because their properties relate to real world situations. The various types of functions may be studied through the analysis of the meaning for various rates of change, zeroes, maximum and minimum values within contextual settings (Heid, 1996). With an understanding of the various families of function, coupled with real world phenomena, connections are established, and students begin to see mathematical models as pictorial representations that have meaning.

Mathematical modeling is a description of the relationship between dependent quantities. The process employs two powerful representations of functions, symbolic and graphical (Schwartz, 1992). The use of graphing technology provides both symbolic and graphical representations of functions. The use of graphing technology enhances students' understanding of the function concept. For example, Heid (1996), used a function grapher and found that when students experience a curriculum centered around applications, their ability to problem solve increases or out performs those of students in conventional algebra classes. Hence, the combination of mathematical modeling and graphing technology offers an outstanding opportunity for teachers to present the function concept in a meaningful manner.

Teachers are often under pressure to teach toward particular goals and outcomes, especially a curriculum driven by high stakes testing, which produces an intended curriculum (Telese, in press). The process of modeling is not necessarily seen as a teaching strategy suitable for obtaining high scores on standardized test. A "survival

trait" for teachers who do not view the advantages of algebraic problem solving is to continue teaching with the textbook and worksheets in preparation for the testing.

An answer to this dilemma is to provide professional development opportunities to facilitate changes in the teacher's curriculum. The intended curriculum is one aspect that influences mathematics teachers' actions. Three other factors are: i) teacher cognition's (Putnam, Heaton, Prawat, & Remillard, 1992), ii) previous experiences of the teacher which includes pedagogical and subject training(Pearce & Loyd, 1987), and iv) characteristics of the teacher's environment (Haimes, 1996). A study conducted by Telese (1996) found that the majority of a high school's Algebra I teachers rarely related the function concept to real life applications and there was a heavy reliance on textbooks and worksheets. This may indicate that the teachers lack a thorough knowledge of functions to fully integrate them into applicable situations or do not have the ability to "see" mathematics in real world events. Haimes (1996) observed that an experienced teacher with a Bachelor's of Science degree in mathematics used a procedural orientation to the teaching of linear functions, although the teacher had a strong background in mathematics she failed to, for example, to place emphasis on the link between functions and equations. Although content knowledge is an important feature of a teacher's background, beliefs about algebra and its teaching provide a powerful influence on a teacher's actions. Through the use of real world problem solving situations, the role of the teacher will change to that of a facilitator, and the teachers will be assisted in the metamorphic process from classroom dispenser of information to a facilitator of information.

Hence, teaching algebra in a unifying manner requires a change in pedagogy. A shift should occur in pedagogical strategies from traditional methods of algebra teaching where, for example, students complete volumes of worksheets to a strategy where students are actively involved in constructing and applying mathematics, with problem solving as a means as well as a goal of instruction. The shift should make available tools, such as graphing calculators and computers, for both learning and doing mathematics in a variety of instructional settings (Heid, 1996). For the shift to be effective, algebra teachers must change their view of the subject and present the content in a meaningful manner.

Project Description

Project GATE(way), Graphing, Algebra, Technology, and Excellence, is designed to indoctrinate middle and high school teachers into situated problem-based learning techniques for algebra classes. The use of technological tools in the algebra classroom is infused with the integrated mathematics and science content. The function concept is presented as a unifying theme in high school mathematics courses. Real world problems, related to the local area, are identified as a focal point for the application of function knowledge in a context. Two major goals of the program are: i) to strengthen teachers' knowledge of mathematics, and ii) to foster the development of strategies for improving the mathematics performance of culturally diverse students.

Teachers experience first hand the process of situational, problem-based learning, which has an underlying foundation taken from both constructivist and problem-based learning theories (e.g., Brooks, & Dunn, 1993; Fosnot, 1996; Savery & Duffy, 1995). A problem stems from the observation of daily phenomenon. Successful problem solving involves the use of a repertoire of tools and knowledge, i.e., procedural and conceptual understanding (Heibert, 1988; Schoenfeld, 1992). When a situation has personal relevance, there is a greater opportunity for learning to occur. With enhanced observational and analytical abilities, a change in one's perceptual field may occur, leading to other insightful observations, the recognition of a problem and its solutions. Through this experience, teachers returned to the classroom armed with content knowledge related to functions and its application to real life phenomenon.

Pedagogical Model

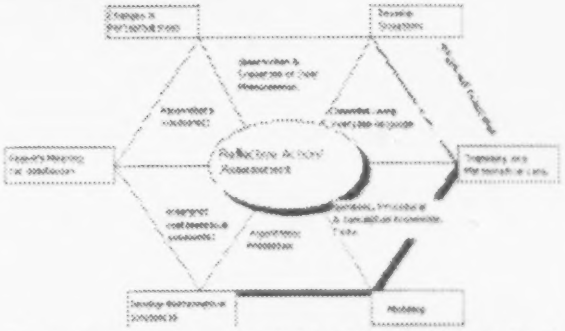

Figure 1 presents a model for the mathematical formulation of real-life problems.

This process represents an individual experience as one begins to see mathematics in our surrounding world. Depending on the individual, there may be more than one starting point. A good starting point is through observation led by a scientific hypothesis, or insightful ideas. The central feature of the model is reflection, which is integral to the other six components. Reflection or metacognitive awareness is the key that begins to unlock and improve perceptual ability, recognize a problem, and to understand the type of knowledge, and tools needed to arrive at a solution. The boundaries between the phases are not static but rather have a dynamic nature. In that, each phase incorporates features of its adjacent phase.

The observation and evaluation of daily phenomenon leads to the change in one's perceptual field. In other words, a change occurs that modifies how a person views

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their world. Mathematics can be seen in many situations, but remains unnoticed unless one comes to recognize the mathematics in real-world events and systems. Situations are then developed using everyday language. The translation of the situation into mathematical language includes the use of mathematical symbols and expressions. During this phase, situational dissonance can occur when an individual's background knowledge does not fully meet with an aspect of the presented information in the problem. A feeling of discomfort develops that interferes with the individual's perception of the situation and perhaps preventing the individual from fully engaging in the situation.

Once the situation is developed, described in everyday language, and translated into mathematical language, the next phase involves the modeling process. To model the situation, the use of various mathematical tools, such as graphs or tables, equations, graphing calculators, and mathematical knowledge-both procedural and conceptual knowledge, are necessary ingredients. Parenthetically, an interaction occurs between the modeling phase and the translation phase because the everyday language translation process into mathematical language also requires both procedural and conceptual knowledge.

The next phase is to develop the mathematical model. As a mathematical tool, algorithmic processes, and other tools, are used at this stage for the creation of the model, leading to mathematical solutions. Note, that algorithms are also used in the prior stage of choosing a model. Since mathematical modeling is a type of problem solving, the use of algorithms, and aspects of mathematical knowledge are necessary to develop a model and seek solutions.

Now that the model has been created, conclusions are made based on the model. This is the stage where the mathematical solutions are interpreted and compared to real world events. The conclusions are tested and evaluated against the real world in order to determine to what degree the model reflects the actual event, or its usefulness. The model may have to be revisited if it shows that it does an inadequate job of predicting. On many occasions, it may be shown that real world phenomena are too complicated and decisions must be made as to what aspects can be ignored to make the problem simpler. Real world solutions then develop as result of applying the model.

Example Situation-Resaca Rangers

The workshop begins with setting the stage for establishing a community of researchers. Participants enter the room while theme music is played. A skit is performed to engage the participants with the situation. They are presented with a series of reports from a hypothetical research organization and are challenged to seek solutions to the presented environmental problems, in this case, the health of resacas. The purpose of the skit to help facilitate the perceptual change necessary to begin to see mathematics in daily phenomena.

The teachers are placed into three cooperative groups based on their area of expertise. Each group addresses a different problem, but each group must supply the other groups with necessary information. Upon receiving the situation, the teachers experience a brainstorming session to seek out methods for obtaining solutions and develop hypothesis. The teachers are introduced to algebraic content related to functions and modeling. Various families of functions are presented in a contextualized fashion, such as linear, power, and exponential, in order to discuss discriminatory methods for choosing the most appropriate model to base predictions. Technological tools are used at this point to enter data and produce graphical representations for the data.

The problem situation dealt with the clean-up of the area's resacas. A resaca is a small body of water, an oxbow, similar to a pond formed by a river. One resaca is nearby one of the teacher's middle school called, Land O'Lakes. Data collected from the resaca included air temperature in degrees Celsius, dissolved oxygen in milligrams per liter, water temperature, and pH. Dissolved oxygen plays an important role in the health of a resaca. The teachers decided to investigate and to model the relationship between water temperature and dissolved oxygen.

The data was entered into a TI-82 graphing calculator, but any other software with similar capabilities may be used. Figures 2 and 3 present a scatter plot of the data for two models, linear and exponential. A discussion ensued related to which family of functions would be the best predictive model. The topics include the correlation coefficient, shape of the curve, and practical significance of the model. There are other variables that may enter into the situation, but in order to make the problem simpler, only the water temperature and the amount of dissolved oxygen were considered. A discussion followed the graphing concerning which model is best for use in making predictions. Topics for the discussion included line of best fit, regression, behavior of the model within given parameters, equations of the line, and correlation coefficient. It was decided after the discussion that the exponetial model was the best model since the amount of dissovled oxygen could only reach a particular value and then level off.

Conclusion

Project GATE(way) emphasized an approach to teaching mathematical concepts through complex and ill structured problems. Opportunities were provided for the participants to experience authentic activities, similar to those that mathematicians/scientists would engage while seeking solutions to problems. Situational problem-based learning is one avenue that may lead to teachers and students to change their perceptual field, to recognize mathematics in real-life situations. The metacognitive skill

of reflection is essential to view mathematics in daily phenomena and using that knowledge to represent the phenomena while seeking solutions to associated problems. One high school teacher commented that his students cannot see mathematics around them. In order to change their perceptual field, he has to ask questions or relate anecdotes that reveal how mathematics is situated around them. A certified middle school mathematics teacher commented, "I thought you had to be a rocket scientist in order to apply math." Both teachers and students should come to the realization that their mathematical knowledge is sufficient and can be used to support research efforts.

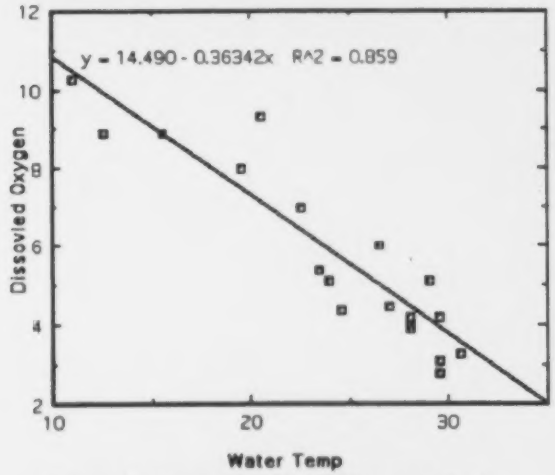

Figure 2. Linear Model of Resaca Data.

Figure 3. Exponential Model of Resaca Data.

The final outcome for the program is confident teachers who have trust in the value of teaching in a meaningful manner although it is not exactly the intended curriculum. To succeed in the use of problem-based scenarios, teachers need to feel comfortable with their ability to incorporate meaningful problem solving activities and technology. The middle school teacher, who thought that only a rocket scientist could model real world events mathematically, at the beginning of the program was reluctant to adapt the presented strategies, but now has the confidence to research data sources and identify problems for use in his class. The changes are difficult to make in the beginning, but with more experience, teachers will gain confidence in themselves to design and implement powerful situations centered around students' interests. The ultimate goal is to foster within students mathematical power, reasoning, and critical thinking skills so that they can take full advantage of their "new civil right."

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Toolkit Approach to Using Spreadsheets in Secondary Mathematics Teacher Education

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One of the central tenets of the current reform movement in mathematics teacher education is that the appropriate use of the tools of technology is integral to teaching and learning mathematics at all grade levels. A major force in this reform, the National Council of Teachers of Mathematics (NCTM), places a high priority on the development and implementation of instructional materials that capitalize on the unique power of these technological tools (National Council of Teachers of Mathematics, 1991). As far as secondary school mathematics is concerned, the NCTM's Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics, 1989) highlights the importance of introducing students to new concepts, such as infinite processes, through extending their knowledge of the properties of functions and algebraic equations. The Standards, however, do not provide specific suggestions about how to accomplish the desired outcomes using the unique power of computing technology. This suggests that secondary mathematics teacher education courses should foster the ability of prospective teachers to design technology-integrated lessons that focus on the development of new modes of thinking through exploring familiar concepts.

In spite of the NCTM's emphasis on technology, a recent report by a task force of the National Council for Accreditation of Teacher Education warns that new teacher education graduates are not prepared to use technology to the fullest extent possible in the classroom (National Council for Accreditation of Teacher Education, 1997). The lack of preparation of mathematics teachers may be due, in part, to a gap between technology offered in mathematics teacher education courses and what new teacher graduates find available in schools. Novice mathematics teachers may be well prepared to teach mathematics using computer graphics, dynamic geometry programs, and other special purpose software to which they were exposed in teacher education courses. However, lacking a tool kit of diverse software in the classroom, novice mathematics teachers may be unclear about how to best integrate technology with only general purpose software available. This paper attempts to address these challenges for computer-mediated mathematics pedagogy and ongoing inservice and preservice programs.

Spreadsheet as a tool kit

In the context of this paper, the metaphor of a tool kit means an array of representational formats which mediate students' mathematical thinking in a technology-rich environment. The major claim of a tool kit approach to teaching and learning mathematics in a computer environment is that the variety of qualitatively different representational formats (notation systems) provided by the environment affects students' acquisition of new concepts in different ways. Such an environment is typically comprised of different computer programs which provide numeric, graphic and geometric notations for the development of mathematical concepts. In particular, the software triple - Excel, Graph Wiz, and Geometer's Sketchpad - was found to be an effective technology tool kit in mathematics teacher education courses (Abramovich & Brown, 1996).

The fact is that the typical secondary mathematics classroom is often not well equipped with a diverse set of mathematical software. Yet, mathematics teachers are required to integrate numeric, graphic, and geometric notations in the teaching of mathematics using the appropriate tools of technology. We argue that one way to overcome this difficulty is to shift the emphasis from specific computer programs to a broader and more sophisticated use of general purpose software, such as spreadsheets, which have become increasingly available at both the secondary and the university levels.

As far as a spreadsheet is concerned, such a shift in emphasis makes it necessary to re-think the concept of a tool kit from multiple programs to a spreadsheet program alone, which can be singled out because it is in itself a tool kit due to its complex and heterogeneous semiotic structure. In this paper, the authors present teaching ideas that concern the use of a spreadsheet-based tool kit in exploring infinite processes. These ideas were included in a mathematics

teacher education course. The course introduced prospective and practicing teachers to spreadsheets and demonstrated how to develop advanced concepts in secondary mathematics using a tool kit approach.

Linking concepts of algebra and calculus through computer graphics

The Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics, 1989) suggest that the study of infinite processes in high school should be based on an empirical approach influenced both by graphical and numerical perspectives. The Standards advocate an informal introduction of advanced concepts. In particular, Standard 13 emphasizes that students should be introduced to infinite processes through extending their knowledge of the properties of functions and algebraic equations. Solving an algebraic equation, such as a linear equation in one variable, is an example of a finite process with which high school students are familiar. Indeed, a solution to a linear algebraic equation can be obtained by performing a number of equivalent transformations. However, a graphic approach makes it possible to look at the process of solving a linear algebraic equation from a new perspective. Computer graphics can play an important role in developing this new perspective for students.

How can a teacher help students make connections between new ideas about infinite processes and their previous experience with algebraic equations? Using computer graphics, a solution to a linear equation in one variable can be introduced as an iterative process. In turn, the geometrization of the iterative process can facilitate the acquisition of the concept of infinity. In the following sections, an algebraic word problem is explored from this new perspective using a tool kit of available representational formats of a spreadsheet environment. The assumption is made that the interaction of these tools facilitates the development of advanced mathematical thinking with regard to the behavior of infinite sequences.

Two Vehicles Problem

A discussion of the following algebraic problem opens the gate for the development of the important concepts of convergence and divergence of infinite sequences.

> The driver of an automobile would like to catch up with a motorcycle that is traveling at one half the speed of the automobile on a long highway. To reach the motorcycle's initial location it would take the automobile 4.5 hours. How long does it take for the automobile to catch up with the motorcycle?

The solution to this uniform velocity problem can be found algebraically. If we let x be the time sought, then there are two related, but distinct, ways to reduce the problem to a linear algebraic equation in the variable x. Although both ways lead to the same solution, it is of great importance to distinguish between the two different ways. First, if one concentrates on the original distance between the vehicles, then the distance can be represented either by Vx-0.5Vx or by 4.5V, where V denotes the velocity of the motorcycle (Figure 1). This leads to the equation

(1) Vx-0.5Vx=4.5V.

Dividing equation (1) through by V, yields 0.5x=4.5, implying x=9. In other words, it takes the automobile 9 hours to catch up with the motorcycle.

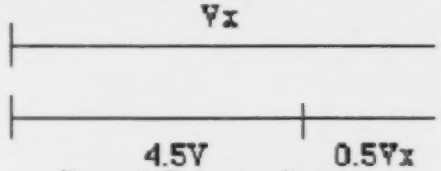


Figure 1. Distance diagrams.

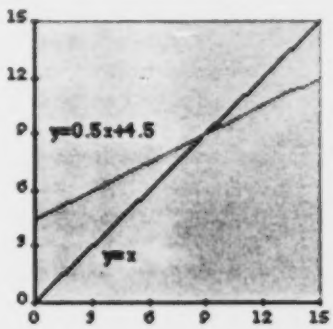


Figure 2. Graphic representation.

Second, one may concentrate on the total distance traveled. Once again, Figure 1 helps to clarify this new line of reasoning. The first solution, involving the difference of distances traveled, can be replaced by a solution involving the sum of the corresponding distances. This yields the equation

(2) Vx=4.5V+0.5Vx, whence x=0.5x+4.5 which gives the same solution, x=9.

While a discussion of equation (1) will be provided later, we would presently like to make the point that equation (2) is not just another mathematical model of the problem in question. Rather, the form of equation (2) is suitable for a graphical solution where one makes use of the graphs of its right and left hand sides (Figure 2). This graphical solution makes it possible to establish a link from students' previous experience with functions and graphs to new concepts dealing with infinite processes. In much the same way as any computer graphics software can be used for graphing linear equations, the spreadsheet program can be utilized to show how the solution may occur from iterating the following recursive formula

(3) xn+1=0.5xn+4.5

starting from an arbitrary seed value x1.

As Figure 2 shows, the graphs of the left and right hand sides of equation (2) are, respectively, a straight line with slope k=1 (the line bisecting the first and third quadrants) and the straight line with slope k=0.5 and y-intercept 4.5. The solution x=9 is the x-coordinate of the intersection point of the lines y =0.5x+4.5 and y=x. The number 9, like any other number, is an abstraction and its image, a point, is a geometric representation of the number rather than the number itself. The point that one sees as a common point for the two straight lines is an approximate geometric representation for the solution of equation (2).

Construction of the bisector-bounded staircase

The above considerations lead to the following geometric process of approaching the exact solution, x=9, no matter how close to the solution one selects a starting point. This process can be described as follows. Take any starting point and mark it x1 on the x-axis. Draw a vertical line segment from (x1,0) to the point (x1,0.5x1+4.5)=(x1,x2) which belongs to the straight line y=0.5x+4.5. Draw a horizontal segment from the point (x1,x2) to the point (x2,x2), which is on the bisector y=x. Continue by drawing a vertical segment from (x2,x2) to (x2,0.5x2+4.5)=(x2,x3), which is again on the line y=0.5x+4.5. Draw a segment from (x2,x3) to (x3,x3), and so on. The resulting geometric construction (sometimes called the bisector-bounded staircase) has the appearance of a staircase trapped between the bisector y=x and the line y=0.5x+4.5. The point (9,9) appears to be the point of attraction for the bisector-bounded staircase. In other words, by iterating sequence (3) one can approach the solution to the two vehicles problem.

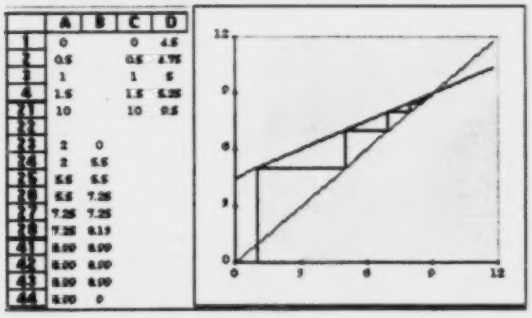


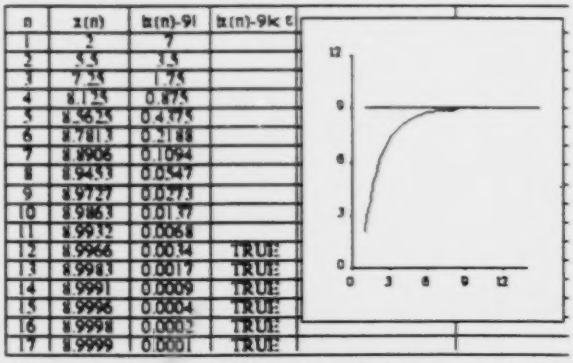
Figure 3: (a) the numeric template; (b) the bisector-bounded staircase.

It is not immediately apparent how a spreadsheet can be used to graph the process described above. Different spreadsheet programs may be developed toward this end. These become more complex as we attempt to create a dynamic environment which makes it possible to visualize the development of different recursive formulas through their geometrization. In particular, the geometric representation of recursion (3) is shown in Figure 3b. A simple spreadsheet program described below can be used to this end. The numeric template shown in Figure 3a should be constructed first. In column A from cell A1 to cell A21 we enter numbers 0, 0.5, 1, ... , 10. Cells C1 and D1 are entered, respectively, with the formulas =A1 and =0.5*A1+4.5 which are then replicated down to row 21. This data is used to bound the staircase. To construct data for the staircase itself, the range A23:B44 is used. Cell A23 is entered with the starting point x1=2, cell B23 is entered with 0 (as the staircase stems from the x-axis). Cells A24, B24, A25, and B25 are entered, respectively, with the formulas =B23, =0.5*A24+4.5, =B24, and =B24. The entire quadruple A24:B25 is then replicated down to row 44. To construct the graph shown in Figure 3, one should highlight the range $A$1:$D$44, and choose the XY-Scatter Format #2 in the Chartwizard menu.

Note that it is possible to make this program dynamic so that one can instantly construct geometrizations of different recursions by changing their parameters (entries of a numeric spreadsheet template). In fact, a more general spreadsheet program was used to generate all staircases/cobwebs pictured in this article. This program is able to instantly generate a geometrization of any iterative sequence of the form xn+1=f(xn).

Visualizing the ?-N definition of limit

The use of a spreadsheet supports an intuitive approach to the concept of a limit through exploring the behavior of iterative sequences. In particular, using the numeric and graphic notations of the



n	x(n)	|x(n)-9|	|x(n)-9|< ε
1	2	7	
2	5.5	3.5	
3	7.25	1.75	
4	8.125	0.875	
5	8.5625	0.4375	
6	8.7813	0.2188	
7	8.8906	0.1094	
8	8.9453	0.0547	
9	8.9727	0.0273	
10	8.9863	0.0137	
11	8.9932	0.0068	
12	8.9966	0.0034	TRUE
13	8.9983	0.0017	TRUE
14	8.9991	0.0009	TRUE
15	8.9996	0.0004	TRUE
16	8.9998	0.0002	TRUE
17	8.9999	0.0001	TRUE

Figure 4. Modeling the ?-N definition of limit with ?=0.005.

spreadsheet-based tool kit, one can explore the limiting behavior of the sequence generated by formula (3). Figure 4 displays how this sequence is ultimately captured in the interval (9-?, 9+?) no matter how small ? is taken to be. By decreasing the value of ?, students can see that it is always possible to come across such a number N so that for all n>N

the inequality |xn-9|<? is true. Thus we have both a numeric and graphic representation of the ?-N definition of the limit of a sequence. More on the use of a spreadsheet in modeling the ?-N definition is described elsewhere (Abramovich & Levin, 1994).

Exploring divergence through the spreadsheet-based tool kit

Proceeding as we did above, the behavior of numeric sequences known as divergence can be visualized. To this end, note that a solution of the Two Vehicles Problem can be approached through equation (1) which can be written in the form

(4) x=2x-9.

In much the same way as in the case of equation (2), students can construct the bisector-bounded staircase for equation (4) using the recursive formula

(5) xn+1=2xn-9.

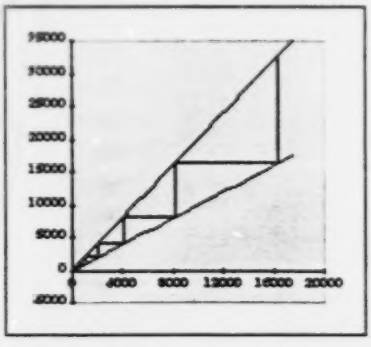


Figure 5. Runaway staircase.

Figure 6. Monotonous divergence.

As Figure 5 shows, the new staircase appears to run away from the point where the bisector y=x and the straight line y=2x-9 meet. The runaway staircase can then be coupled with the diagram of Figure 6, which incorporates numeric and graphic notations of the spreadsheet. In this way, one can visualize the process of divergence using three different representations - the geometric representation (a bisector-bounded staircase), the numeric representation (a numeric template) and the analytic representation (a graph on the (x,y)-plane).

At this point, the important question that can be raised is: What is the difference between Figure 3b and Figure 5? In other words, what is special about a straight line that allows the staircase to be attracted by the point of concurrency (9, 9)? The visual analysis of the diagrams makes it clear that the slope of a straight line should not exceed 1 in absolute value in order for a point of concurrency to be a point of attraction (Figure 3b). Bruce, Giblin, and Rippon (1990) provide a detailed discussion of the behavior of iterative sequences.

From bisector-bounded staircases to cobweb diagrams

Mathematics education research suggests that teaching the concept of a limit of a sequence through examples of monotonous sequences may cause misconceptions which, in turn, may lead to erroneous operations with limits. Using a spreadsheet as a visual aid for calculus, sequences exhibiting more complex behavior can be introduced. For example, one can rewrite equation (2) in the equivalent form

(6) x=-0.5x+13.5

(which also has the root x=9), and then construct the bisector-bounded staircase for the related iterative sequence xn+1=-0.5xn+13.5. In the same way, one can rewrite equation (2) in the equivalent form

(7) x=-2x+27

(which also has the root x=9), and then construct the bisector-bounded staircase for the related iterative sequence xn+1=-2xn+27. These staircases, known as cobweb diagrams, are shown in Figure 7 and Figure 8.

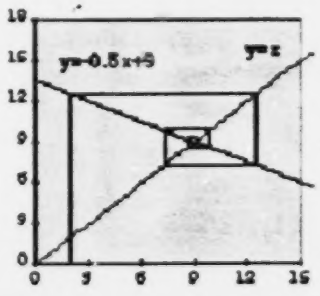


Figure 7. Oscillating convergence.

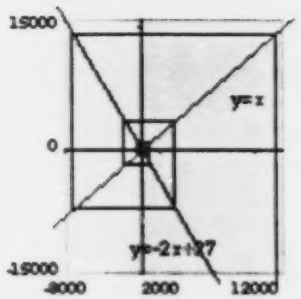


Figure 8. Oscillating divergence.

The pictured cobweb diagrams represent processes called oscillating convergence and oscillating divergence, respectively. The diagrams can be complemented by the numeric and graphic representations of these processes.

To conclude this section note that yet another equivalent form of equation (2) leads to the recursion $x_{n+1}=-x_n+18$, which can be used to introduce the concept of periodicity (cycles). Finally, through the spreadsheet-based geometrization of the piece-wise recursion $x_{n+1}=1-|2x_n-1|$, students can also be exposed to chaotic behavior of infinite sequences. The use of spreadsheets to introduce chaos through exploring the intriguing behavior of quadratic-like sequences is discussed by Abramovich & Levin (1993), Durkin & Nevils (1994), and Iseke-Barnes (1997).

Conclusion

Because of the increasing availability of computer spreadsheets, the authors believe that mathematics teacher education courses may consider re-thinking the concept of a tool kit from multiple programs to this single type of program. This paper demonstrated how the complex semiotic structure of the spreadsheet makes it possible to use a single computer program as a tool kit. The advanced topics in secondary mathematics discussed above were chosen to illustrate this point. However, in an attempt to conceptualize the tool kit approach as a framework for technology-mediated mathematics teacher education research and development, the major questions to be answered are: (i) What is special about each element of the array of representational formats available in the spreadsheet environment ? (ii) Can these elements be distinguished in terms of their representational power ? (iii) To what extent can any two notation systems of the spreadsheet be considered cognitively equivalent to each other in terms of their representational power ? The authors will elaborate on these questions in a separate paper.

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When Teachers Meet CAS Technology

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The idea of using computers to perform symbolic rather than numerical calculations led to the development of Com puter Algebra Systems (CAS) in the early sixties (Harper, Wooff & Hodgkinson, 1991). In the mid-eighties the availability of CAS for personal computers attracted mathematics educators to the possibility of using them in the classroom. CAS technology with its powerful combination of numeric and symbolic computation, 2D & 3D graphic and programming facilities is a natural and logical continuation of the scientific and graphical calculators that have become popular in school mathematics. Each new technology greatly affects the way mathematics is practiced and CAS technology is a big step forward. Most teachers, however, are not aware of the existence of CAS software. Teacher education is an important factor for the successful integration of CAS (Zehavi, 1996; Lachambre & Abboud-Blanchard, 1996). In considering the future needs of teacher preparation and involvement, we have designed and implemented a 90-hour professional development course with the following goals:

- To enable teachers to take advantage of the new possibilities offered by CAS, to refresh and extend their mathematical knowledge.
- To have teachers experience learning with this new technology as a motivation to acquire further knowledge, to experiment with CAS and use it in their teaching.
- To familiarize teachers with CAS and make it an integral part of their mathematical environment.

After an initial introduction to the computer algebra system, Derive (Soft Warehouse), teachers begin working on problems at their own level. In doing so they become aware of how CAS can assist their own mathematical thinking, especially regarding the multiple representations available by the softwar. Mathematicians, educators, and policy makers have asked how computer algebra will affect mathematics education. Studying its use by teachers can provide further knowledge and enable better implementation of it in the classroom.

Two examples will be presented from tests given in the course. The first one is a problem that was given after one-third of the course. The problem became a turning point for the teachers; they realized the use of CAS as a cognitive technology (Hillel, 1991). The second problem was given toward the end of the course and helped transform teachers to the stage where they began to rethink pedagogical and curricular aspects of mathematics.

Example I

The first three parts in the course include examples from number theory, a wide range of symbolic manipulations, and illustrations of the advantages of graphical representations. In the test that was given to the teachers at this stage we used a problem taken from Alan Schoenfeld's mathematical problem-solving class, cited by Arcavi (1994).

"Explore the relationships between the values of 'a' and the number of solutions of the pair of equations:

x2 - y2 = 0
(x - a)2 + y2 =1"

Since the problem is stated in algebraic terms the teachers used Derive to perform the laborious algebraic manipulation. The solution, x = 0.5(a ± v(2 - a2)), led to the interpretation that "any solution of x represents two points in the plane", ignoring when x = 0, which occurs for a = 1. Some teachers also tried to change the representation to graphics. Derive enables implicit plotting of equations. Figure 1 shows the graph of the first equation, which is represented as two lines, y = ±x, and several circles whose centers lie on the x-axis for specific values of 'a'. We can see that when a = 1 there are three rather than four intersection points. After observing this some teachers performed a multi-representation analysis of the problem and gave the correct answer of 0, 2, 3, or 4 solutions: for |a| > v2 there is no solution; for a = ±v2 there are two solutions; for a = ±1 there are 3 solutions; and for |a| < v2, a ? ±1 there are four solutions.

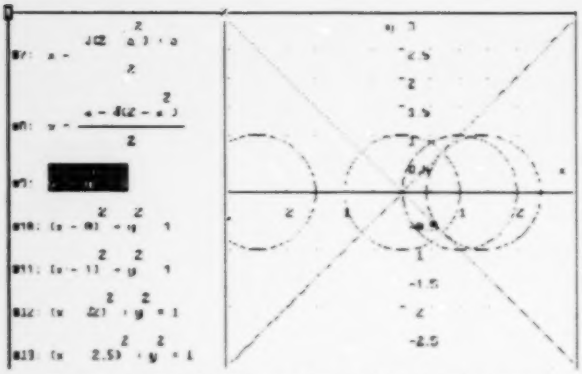

Figure 1: Symbolic and graphical solutions

The distribution of the teachers' responses (n = 25), presented in Table 1, reveals their solution strategies:

Table 1.

Method	Correct solution	Wrong solution
Symbolic	4	7
Symbolic and graphic	10	1
Graphic and symbolic	1	2

The reaction of those teachers who got a wrong answer, even when using a symbolic manipulator, was very marked. The following anecdote describes a change of attitudes. After the test, one of the participants, a quite experienced high-school teacher, compared notes with another teacher. She would not agree about the possibility of three solutions. He suggested plotting. She said, "I am pragmatic, the graph does not add information, it just illustrates what we know. I like solving the algebra with Derive and that should be enough." He explained how implicit plotting, when a = 1, helped him complete the solution and understand the algebraic explanation. When she found her mistake she became enthusiastic and changed her approach, "I must educate myself to use the graph more seriously, especially when implicit plotting is available." Here the new facility, namely, implicit plotting integrated with the symbolic mechanism of the software enhanced cognitive mathematical integration.

Example II

The second problem, although appears simple is even less standard than the first one (Bruckheimer & Inbar, 1995).

"Search for three numbers for which the sum is -9 and the their product is -20.

What is the range of the solutions?"

The solution of the problem is rich in mathematical relationships and thus requires the solver to coordinate actions among different mathematical representations. The teachers became very involved in creating their own representations (some of them even surprising the course team), and they suggested follow-up ideas for teaching.

The teachers were asked to submit their answers including screen dumps and annotated Derive files created while solving the problems. The files enabled us to see the order of actions performed for solving each problem. The screen dumps revealed the mathematical and pedagogical ideas that the teachers wanted to emphasize. For example, one teacher chose to present Figures 2 and 3. Figure 2 contains the symbolic manipulations performed by the software. Line #4 shows the bivariate equation that describes the problem. Solving this equation for y gives two functions (in lines #5, #6), and we can see then how the range of the solution was calculated. Figure 3 compares two graphical representations of the problem. The graph on the left side was obtained simply by the automatic implicit plotting of the software. Note that if plotting is performed in the standard graphical window only some parts of the graph are seen. Clearly, the expression that describes the problem, x.y(x+ y + 9) = 20, is symmetric for x and y - and thus we must zoom out until we obtain a symmetric graph and then set the adequate scale. The right-side graphical window contains an unusual representation created using the VECTOR function, a helpful feature of Derive for quickly investigating and the presenting results. A vector is a row of elements separated by commas and enclosed in square brackets which is generated algebraically. In the current example "vector(x.y(x + y + 9) = 20, y, -20, 20, 1)" comprises 41 equations that need to be solved for x. By one key stroke the results can also be plotted illustrating the geometrical properties of the mathematics. Figure 2-3 show three representations of the solutions for x in the range x > 0, x < -11.623, -5 < x < -1.372.

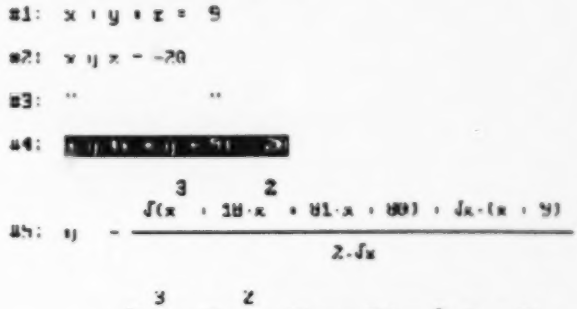

Figure 2: Symbolic solution

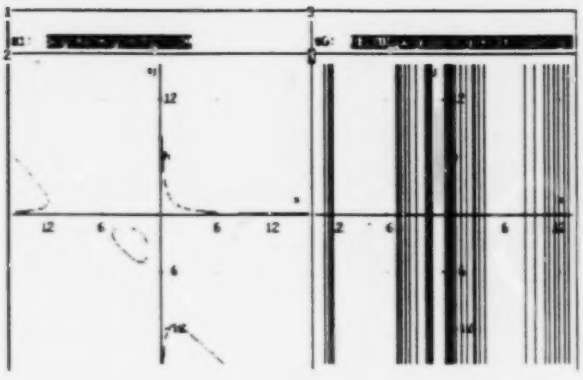

Figure 3: Two graphical representations

In checking the teachers' answers we had the following categories:

(a) Correctness of the answer

Most of the teachers identified the correct domain. About 25% gave a partial answer.

(b) Type of initial strategy

At this stage of the course the teachers were very enthusiastic about the availability of implicit plotting, and therefore more than half of them started to solve the problem graphically. Some elaborated this representation, as explained previously, whereas others switched to the symbolic manipulation. Many teachers experimented first with specific numerical values before analyzing the general case.

(c) Additional creative representations

The representation in the right-hand side window of Figure 3 surprised the course team. We suggested adding the symmetric vector which goes for x and yields y solutions. There were other interesting ideas. Three teachers combined algebraic work and graphs in the following way.

#1: x + y + z =-9
#2: x.y.z = -20
#3: z:= 15
#4: z:= 10
#5: z:= -10

They drew conclusions from solving algebraically and graphically the first two equations for different values of z.

Another remarkable representation used the 3-D graphic window to plot the bivariate expression MAX(-9 - x - y, -20/(x.y)).

(d) Related teaching ideas

The teachers were asked to solve the problems at their own level and were also asked to suggest related activities at the student level. Here are several follow-up ideas.

- Using equations like 15y(y + 9) = 20 to practice manipulations with irrational numbers.
- Comparing properties of other interesting expressions and their graphs: e.g., domain, symmetry, endpoints, extrema.
- Illustrating inverse functions.

Conclusion

During the course we identified four stages of teachers' technological professional development:

1. Initially teachers are skeptical about the possible contribution of technology to teaching and learning. However, they are curious enough to familiarize themselves with the new technology.
2. Teachers adapt readily to the symbolic mechanism of the software and make it their professional tool for doing mathematics. The graphical representations are used only for illustration.
3. Teachers view the new technology as encouraging versatile thinking in mathematics.
4. Teachers believe that CAS technology requires continually rethinking the pedagogical and curricular aspects of mathematics.

The first example presented helped to transform teachers from the second to the third stage and the second example motivated teachers to reach the fourth stage. The coursework made teachers aware of the variety of possible preferences for processing information when carrying out a learning activity, in addition to providing teachers with many teaching ideas. They all expressed their desire to participate in a follow-up course for designing curricular materials.

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Dr. Super's Virtual Manipulatives Project: An Innovative Web-Based Instructional Strategy

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The World Wide Web (WWW) is becoming one of the fastest growing resources available to educators today. Its vast resources are being utilized more and more for research, data collection, communication and instructional delivery in nearly every field and content area. In fact, this medium has the potential to revolutionize the way instruction is delivered. However, educators are only beginning to test the instructional value of this 'network of networks'. Currently the majority of instructional content on the WWW demonstrates a very low level of interactivity and engagement with the instructional content primarily delivering information in a static manner through displaying textual and graphical information on Web pages. From an instructional viewpoint, this limited interaction can be viewed as didactic in delivering or providing information to students rather than giving them the opportunity to interact with the material and become cognitively engaged. Due to recent software developments, instructional modules on the WWW can engage the user in dynamic activities and cause deeper cognitive processing of the content. In contrast to the more common approach of static display of information on the Web, a few innovative examples of Web-based educational material with engaging interaction strategies are beginning to emerge. Dr. Super's Virtual Manipulatives project offers this interactive potential.

The Dr. Super's Virtual Manipulatives project is an example of an evolving instructional curriculum for 4-8th grade which represents the dynamic interaction possible on the WWW. Essentially, the project creates virtual manipulatives which are computer versions of commonly used physical manipulatives such as multi-base blocks, alge blocks, attribute blocks, tangrams, Dr. Super's Triangles, etc. Using the mouse, students can slide, flip, and turn on-screen manipulatives in order to explore their properties and use them in solving mathematical problems that are authentic in nature. The virtual mathematical manipulatives are depicted as movable and scaleable graphical objects which are manipulated by students to assist them in learning spatial relations, problem solving, arithmetic, and other math skills.

Currently, the Dr. Super's Virtual Manipulatives Project is supported at George Mason University as an innovative Web-based instructional approach to the teaching of mathematics. Based on established curriculum ideas using concrete manipulatives, the Dr. Super's Virtual Manipulatives Project provides students with an opportunity to become actively engaged with mathematical concepts in a fun and interactive manner.

Theoretical Basis for Dr. Super's Virtual Manipulatives Project

Mathematical manipulatives have been used extensively in the concrete form and have been shown to enhance mathematics achievement (Suydam, 1984). Manipulation of the parts of an object may allow for students to actively form their own generative associations in relating the parts together. Manipulations of objects may enhance students' abstract representations allowing students to potentially achieve a higher level of learning (Haag, 1995)

Opportunities for higher level learning goals also exist for computer-based manipulative objects, referred to as Virtual Manipulatives (Spikell & Aghevli, 1997). Virtual manipulatives are a relatively new instructional approach. Allowing for student-directed engagement with objects on the screen, the computer's direct manipulation interface enables learners to move and interact with visuals through mouse input (Hutchins, Hollan & Norman, 1986). Manipulating computer generated objects, students have the opportunity to explore spatial relationships through generating new associations and concepts about the objects. This type of activity places students in control of their own learning and creates the potential to apply newly discovered

concepts to other learning situations, and apply discovered concepts to new learning situations.

Unlike most computer-supported learning environments which are firmly rooted in behavioral psychology (Kember and Murphy, 1990), the virtual manipulatives concept is generative in nature. By allowing the learner to have an active, participatory role in constructing and interpreting individual meaning from information (i.e. through direct manipulation interface) (Wittrock, 1974a; Wittrock, 1974b), learning becomes the generation of meaningful relations between knowledge and experience (Wittrock, 1992).

Although the effectiveness of virtual manipulatives has not been empirically tested, there is evidence that concrete manipulatives contribute to problem solving skills (Suydam, 1984). Therefore, it is expected that virtual manipulatives may also have this potential. The National Council of Teachers of Mathematics maintains that computers are important tools to assist students with the exploration and discovery of concepts allowing a smooth transition from concrete experiences to abstract mathematical ideas (Perl, 1990). Accordingly, Alesandrini (1984) believes it is the act of manipulation that seems to be important.

Virtual manipulatives may provide a strong link in the learner's mind from physical, concrete objects to the semi-concrete representation of concepts on computer, therefore, enhancing abstract thought (Berlin & White, 1986). Through the use of virtual manipulatives, the learner is actively participating and cognitively engaged in the instruction by physically maneuvering visual elements. This may provoke the conscious construction of associations between various visual elements as well as the association between those visuals and the learner's prior knowledge (Haag, 1995). Furthermore, learning is enhanced when students can hypothesize the placement of graphical elements, configure the objects on-screen and evaluate the impact of their actions. Mathematical concepts are synthesized in this iterative process as students use their invented configuration to solve complex problems.

Incorporating a constructivist approach and principles from Roger Schank's Goal-Based Scenarios, virtual manipulatives are best introduced by a story or situation. By following a created cover story which involves a mission, students plan their operations and test out their approaches. This context furnishes a rich learning environment to support students' acquisition of spatial relations and problem solving skills.

One of the components which makes the use of Dr. Super's Virtual Manipulatives Project so unique is the ability to make the task at hand authentic. "Authentic tasks," state Brown et al. (Brown, J.S., Collins, A.S. & Duguid, P., 1989) , "are coherent meaningful and purposeful activities that represent the ordinary practices of a culture. These tasks involve activities that practitioners and experts engage in during real problem-solving rather than the simulated processes typically demanded in formal schooling (Wilson, 1993). According to Scardamalia, M., Bereiter, C., McLean, R. Swallow, J., & Woodruff, E. (1989), real world tasks...tend to be wide open in the kinds of knowledge that may be drawn on in handling the task. Rather than have students learn arithmetic facts or geometric concepts and relationships in isolation, meaning is derived from the situation in which it is presented. Because the emphasis is on providing enabling experiences in authentic versus decontextualized contexts, it promotes understanding that cultivates learning processes rather than learning outcomes (Choi and Hannafin, 1995).

This authenticity has great motivating potential. Students construct unique understanding of geometric principles through interaction with the real world context and are guided toward the application of these concepts to a realistic situation. Quite often in traditional classrooms students are given problems or tasks that have little relevance or meaning (Newmann, 1991). Conversely, authentic tasks are ordinary activities in relevant situations that purposefully engage the learner and possess extraordinary motivational potential (Choi and Hannafin, 1995).

The Dr. Super's Virtual Manipulatives Project is also designed to attempt to facilitate transfer of skills from one context to another. By providing contextual anchors students learn to use their knowledge flexibly as a tool to deal with everyday, as well as novel, situations (Choi and Hannafin, 1995). In support of this, Collins (1988) maintains that lesson content, when acquired in meaningful contexts, becomes more transferable because the context provides support for its use. This approach to learning capitalizes on students' ability to create interpretations for themselves (Cunningham, 1991) and actively manipulate the material until it makes sense (Perkins, 1991). Learners, in turn, reference their personal experiences and apply strategies which evolve through interaction with the program and other students. In this way, knowledge is not simply being transmitted, but instead opportunities for meaningful learning are created.

Another way in which meaningful learning occurs is through group interaction. The Dr. Super's Virtual Manipulatives Project activities can be used in a cooperative environment whereby students are given the responsibility to contribute to each other's learning. According to Scardamalia et al. (1989), in order for cooperative learning to occur, students must recognize what they are trying to learn, value it and wish to share its value. With the project's activities students are encouraged to collaborate and share their efforts and ideas to solve the problems and tasks at hand.

This cooperative approach allows students to construct multiple perspectives on an issue as well as appreciate and

understand alternate views. Students are encouraged to evaluate and defend these different perspectives, identifying shortcomings as well as strengths. By collaborating their efforts and defending their answers, ultimately students will adopt the perspective that is most useful, meaningful or relevant to them in that particular context (Bednar, A.K., Cunningham, D., Duffy, T.M., & Perry, J.D., 1991).

Finally, the evaluation portion of the Dr. Super's Virtual Manipulatives Project materials involves asking learners to address a problem posed in the context of the situation and defend their decisions. Reflecting the constructivist view, content and process are blended to encourage meaningful learning. Bednar et al. (1991) expand on this with the belief that the two most important elements of evaluation include 1) the ability to function within a given discipline and 2) the ability to defend judgments. In contrast to the mastery model, the program does not lead students to one answer or set of answers that is correct. Because students will approach this program from a variety of backgrounds and collaborative efforts, interpretations of learning experiences as well as students' applications of their learning will lead to a variety of responses. Evaluation, therefore, centers around students' ability to explain and defend their perspectives.

Classroom Implications

Concrete manipulatives have been shown to be effective in students' assimilation of complex ideas and skills in mathematics. Traditionally, other static representations depicting graphical objects have also been used in mathematical instruction and do not allow for dynamic interaction with the content. Virtual manipulatives as developed by the Dr. Super's Virtual Manipulatives Project , however, permits increased student interaction and provides a representation that goes beyond merely pictorial. Students flip, slide, turn and scale virtual versions of manipulatives which consist of geometric shapes to study and master mathematics concepts and skills in a context rich setting. By using the virtual manipulatives as an extension of the concrete manipulatives, students are able to continue this discovery process and make the leap from concrete to more abstract thinking.

In the classroom environment virtual manipulatives have strong curricular implications either through teacher-directed, student-directed or independent learning. The context rich and authentic activities provide opportunities for either individual or collaborative problem solving efforts. Students are encouraged to reflect on the strategies used to solve math puzzles or problems while recognizing the interrelationship of components.

Because the Dr. Super's Virtual Manipulative materials are designed for cooperative learning, there is potential for a group of students to be actively engaged in a "virtual learning environment" while the teacher conducts small-group instruction for the remaining students. Therefore, a classroom with six computers could essentially occupy twelve students. Most "virtual lessons" are broken into approximately 30 minute segments and allow for instruction independent of teacher support. Furthermore, objectives are easily identifiable so teachers can choose activities to enhance classroom instruction.

Virtual manipulatives can help foster an understanding of a variety of mathematical concepts which include but are not limited to, perimeter, area, conservation of matter, fractions, whole number arithmetic and writing abstract algebraic expressions. Furthermore, the virtual manipulatives can incorporate a language arts component giving it useful cross-curricular implications. Through reflection and journal responses students can verbally express their own problem solving approaches. Students can also use the virtual manipulatives to construct their own activities or puzzle problems and then create their own cover story in order to give meaning to their own experiences with this content.

A final advantage to the virtual manipulatives is that they provide an alternate form of instruction for students coming into learning situations with varied backgrounds and learning styles. This may be especially valuable for students whose personal learning styles are not suited to the pace and public quality of classroom learning (Scardamalia et al., 1989). Furthermore, this vehicle of instruction provides for self-paced learning that allows time for reflection to think about what they are doing and why. Students are encouraged to interact with the program and ask questions it might bring to mind in a safe, non-threatening, private environment.

Historical Roots of Virtual Manipulatives

The Dr. Super's Virtual Manipulatives Project is a curriculum research and development effort of the Metamedia Mathematics Program at George Mason University. Students enrolled in the doctoral and master's degree programs work directly and collaborate with faculty in the Graduate School of Education, the School of Technology and Engineering, as well as with teachers and students in various northern Virginia schools to develop virtual manipulatives activities for grades K-12.

The Super Mosaic Apprentice Activity, An Example of Dr. Super's Virtual Manipulatives Project

Although there are a variety of applications using the virtual manipulatives being developed at George Mason University, one, the Super Mosaic Apprentice Activity, provides a particularly context-rich application. It is based on a new set of physical manipulatives consisting of small, medium, and large multi-colored triangular shapes. The Super Mosaic Apprentice Activity provides a learning situation whereby students are encouraged solve a variety of problems as they relate to the creation of mosaic designs

using geometric concepts and principles. A company which manufactures mosaic tiles and its goals (mosaic tile creation) are initially introduced to the students, and their job as "employees" will be to learn to design mosaics after learning the "tricks of the trade" (a.k.a. geometric skills). They are required to work within certain parameters (i.e. limitations set by geometric definitions) established by the head of the company. Students will directly interact with the computer to manipulate the mosaic pieces to meet each successive goal of the assigned project. Each of the computer-based activities is designed to last approximately 30 minutes. Skills and concepts are introduced in the context of the task at hand, as the activity is designed to build interest with realistic directions and purpose for given tasks. Variations of the Super Mosaic Apprentice Activity can also be developed for existing physical manipulatives such as Dr. Super's Triangles (Creative Publications) or Trigrams (Stokes Publishing Company).

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Guidelines for Developing Mathematical Activities Incorporating Technology

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The Center for Technology and Teacher Education at the Curry School of Education is currently funded to develop materials to help pre-service and in-service secondary mathematics and social studies teachers incorporate technology into their teaching. The Center's mathematics group is focusing their efforts on developing activities that will prepare teachers to use technology to enhance and extend students' learning of mathematics. We acknowledge that technology can be used effectively by teachers to present information, search for information, keep records and communicate, and that such uses of technology by teachers can result in improved student learning. However, we believe that the most direct and effective way to bring about enhanced student learning of mathematics through technology is to prepare teachers to incorporate into their teaching classroom and project activities that will engage students in technology-augmented mathematical thinking. Hence, our materials for teachers will be developed around significant mathematical activities for students. We are currently devising a set of guidelines to help shape our development of these activities and materials. At this point we are following the guidelines below:

Introduce technology in meaningful mathematical contexts. Features of technology, whether mathematics-specific or more generic, should be introduced and illustrated in the context of meaningful content-based activities. Teaching students a set of technology or software-based skills and then trying to find mathematics topics for which they might be useful is comparable to teaching students a set of procedural mathematical skills and then giving them a collection of "word problems" to solve using the procedures. Such an approach can obscure the purpose of learning and using technology, make mathematics appear as an afterthought, and lead to contrived activities and curricular fragmentation. The use of technology in mathematics teaching is not for the purpose of teaching about technology, but for the purpose of enhancing mathematics teaching and learning with technology. This guideline is in accord with the first recommendation of the President's Committee of Advisors on Science and Technology, Panel on Educational Technology (1997): "Focus on learning with technology, not about technology" (p. 7).

Use technology to address worthwhile mathematics and support appropriate pedagogy. Content-based activities using technology should address worthwhile mathematics concepts, procedures and strategies, and should reflect the nature and spirit of mathematics. Activities should support sound mathematical curricular goals and should not be developed merely because technology makes them possible. Moreover, the use of technology in mathematics teaching should support and facilitate conceptual development, exploration, reasoning and problem solving, as described by the National Council of Teachers of Mathematics (NCTM, 1989; 1991). Technology-enhanced activities should involve students in higher-order mathematical thinking and should not engage students in carrying out procedures and finding answers without appropriate mathematical and technological understanding. This guideline is in accord with the second recommendation of the President's Committee of Advisors on Science and Technology, Panel on Educational Technology (1997): "Emphasize content and pedagogy, and not just hardware" (p. 7).

Take advantage of technology to enhance teaching. Activities should take advantage of the capabilities of technology, and hence should extend beyond or significantly enhance or facilitate what could be done without technology. Using technology to teach the same mathematical topics, in fundamentally the same ways, that could be taught without technology does not enhance students' learning of mathematics and belies the usefulness of technology. Furthermore, using technology to perform tasks that are just as easily or even better carried out without technology may actually be a hindrance to learning. Such uses of technology may convince teachers and administrators that preparing teachers to use technology is not worth the considerable effort and expense necessary to do so.

Connect mathematical topics. Technology-enhanced activities should help students connect mathematics to real-

world phenomena, and/or interconnect mathematical topics. Appropriate use of technology can facilitate such connections by providing ready access to real data, by making the inclusion of mathematics topics useful for applications previously impractical (e.g. recursion, regression) possible by removing computational constraints, and by making it easier for teachers and students to bring together multiple representations of mathematics topics (see below). This guideline supports the curriculum standards of the National Council of Teachers of Mathematics (NCTM, 1989).

Incorporate multiple representations and multiple approaches. When apropos, activities should incorporate multiple representations of mathematical topics and/or multiple approaches to representing and solving mathematics problems. Research shows that many students have difficulty connecting the verbal, graphical, numerical and algebraic representations of mathematical functions (Goldenberg, 1988; Leinhardt, Zaslavsky and Stein, 1990). Appropriate use of technology can be effective in helping students make such connections. Furthermore, use of technology allows students to set up and solve problems in diverse ways, involving different mathematical concepts, by removing both computational and time constraints.

The above set of guidelines is still evolving along with our work, and we expect that they will be modified as our work continues. We are aware that there are worthwhile mathematics activities that do not conform to all of these guidelines, and hence we do not intend to apply the guidelines, as a set, rigidly to all of our developed materials. We do not want the guidelines to eliminate otherwise useful activities, nor do we want them to lead to contrived activities. Although, a guideline such as "...address worthwhile mathematics and appropriate pedagogy," should always be followed, whether using technology or not.

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Looking at the Quality of Web Sites

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There is LITTLE question about the potential of the use of the World Wide Web in classroom learning. The ease of use, the immediacy of information, and the global viewpoints, allow learners to generate meaningful learning for themselves. But the BIG question is what to do with all of this information. Is the information accurate? Is the information free of cultural, gender, and age bias? Simply because the information on the Web is easily accessible, is it the best resource for the information that is needed? Glitz and glimmer can be great motivators but are they needed in all areas of learning? For all learners? With the extensive use of hypertext on the WWW, issues of cognitive mapping and cognitive flexibility also come into question. This paper will highlight some of these issues and pose questions that need to be answered about remaining issues. It will also include on-line resources that can be used to help in the evaluation of World Wide Web educational sites.

World Wide Web's Potential in Education

Today's educational systems are in the midst of change, chaos and confusion. The curriculum that we have determined to be what needs to be "learned" is no longer relevant. Requiring students to learn facts, as is common under the didactic system that is evident in so many school and schools districts, is no longer a viable proposition. We need to equip our students with all the necessary skills to be able to locate and evaluate any information they need. they must become information managers, not information regurgitators (Mann, 1994). In order for this to occur, information on the World Wide Web (WWW) must relate to the curriculum and the ability of the students who will use the information to help them organize the information into learning.

Another job for today's busy educators - evaluate the resources that will facilitate students' learning, or better yet, teach the students to evaluate the site themselves. Is this job as important as teaching students to read, to add, to take tests? If one reads and studies the literature on using the WWW as a resource for learning, the answer is a resounding YES! (Schrock, 1997; Collins, 1996; Descy, 1996; Engle, 1996; Ormondroyd, et al., 1996; Tate & Alexander, 1996).

Okay. So now what? What do we as educators need to know in order to evaluate sites and to support our students' learning of this process of evaluation?

Evaluation of Information

Much of the literature concerning the evaluation of WWW sites has been written by educational librarians. Who better to do so. These remarkable generalists have been working with the evaluation process for many years. This is what they have been educated to do. Librarians and other information professionals have developed a set of criteria that they use to evaluate information in books, journals, magazines, pamphlets, etc. (Smith, 1991). In short, they study the format, scope, relation to other works, authority, treatment and cost (Hinchliffe, 1997).

These aspects of information found on the WWW are also of importance. But, there are even more details that need to be studied and evaluated before information from the WWW can be determined to be useful and appropriate.

The remainder of this paper will deal with a synthesis of ideas, concepts, and details that various educators (librarians, media specialists, classroom teachers, university professionals) have designated as important in the evaluation process of WWW educational sites.

We distinguish between educational sites and other sites as those that contain information that relates to curriculum issues, problem solving, and research opportunities, and cooperative or collaborative projects that are part of the Web.

Criteria for Evaluation Educational Web Sites

Twenty-five educational resources were used to gather information for the synthesis that follows. These resources were found in research journals, journal articles, and on-line sites. There are currently on-line and off-line resources that include a "top-ten list" of web sites. This is one place that educators "could " begin when initiating use of the WWW. However, all of these resources may not have education/ curriculum in mind when they are conducting their evaluation. For example, some evaluate the design but do not look at the content. These resources include Lycos Top 5%, Webcrawler Best of the Net, and HotBot, just to name a few.

According to the resources that we read and studied, the following are the criteria for evaluation of educational web sites. To determine if a site meets these criteria, ask the following questions:

Accessibility

- Who are the intended users and is the level of information provided appropriate?
- Do parts of it take too long to load?
- Is the site open to everyone or do parts require a fee?
- Is the site available on a consistent basis?
- Can the resource be accessed easily, or are there special software, password, or network requirements?

Accuracy

- Is the information in the resource accurate?
- How does this information compare with that in other sources in the field?

Authority

- Does the resource have some reputable organization or expert behind it?
- Can you tell who the author(s) is (are)?
- Does the author have a standing in the field?
- Are sources of information stated?

Content

- How comprehensive is this site?
- What is the relationship to curriculum?
- What is the purpose of the resource? Is this clearly stated?
- Is the content organized by the needs of the user, or does it reflect an internal hierarchy?
- Is the origin of the information stated?
- What is the scope of the site - what is included as well as what is excluded?
- Does content format vary - text, video, audio, etc.?

Cooperative/Collaborative Projects

- Is collaboration between schools, universities, government agencies, and businesses a vital part of the site?
- Can students from around the world exchange data on topics?

Correct Grammar

- Does the text follow basic rules of grammar, spelling and literacy composition?
- Is the site organized logically?

Currency

- How frequently is the resource updated, or is it a static resource?
- Do the stated dates correspond to the information in the resource?
- Is the publication date clearly labeled?
- Is the information primary or secondary in nature?

Ease of Use

- Is navigation through the page easy and logical?
- Who are the intended users of this resource?
- Does this resource work with multiple browsers (Netscape, Microsoft Explorer. etc.)?
- Does the three-click rule apply to this site? If it takes more than three clicks to get to something useful or interesting, then it's buried too deep.

E-mail

- Is contact information for the author included in the document?
- Is a mail-to link offered for submission of questions or comments?

Graphic Design

- Does the document follow good design principles and do the graphics serve a function or are they decorative?
- Is the writing style appropriate for the intended audience?
- Are the web pages concise, or do you have to scroll indefinitely?
- Do all of the parts of the site function correctly?
- Does the site look and feel friendly?
- Are the pages readable? Does the color of the background or font preclude ease in reading the information?

Interactivity

- Does the site facilitate person-to-person interactivity?
- Can students share and display their work?
- Does the content facilitate independent investigations as well as cooperative problem solving?
- Can users communicate with "the experts" in the field?

Linkage to Other Appropriate Sites

- Are links relevant and appropriate?
- Do links to remote sites work?

Multimedia Capabilities

- Does the site use unique features of multimedia to accommodate multiple modalities and learning styles?
- Is the quality of sound, as well as the time for downloading of sound files, appropriate and worthwhile for the learning environment?

Objectivity

- Is any sort of bias evident?
- Are there political or ideological biases?
- Does the material inform? explain? persuade?
- Is there advertising on the page, is it clearly differentiated from informational content?

Search engine

- Is a search engine provided?

Uniqueness of Information

- To what degree of redundancy does the content have with other traditional resources?
- Is this the best resource for achieving the purpose intended?
- Is information in this resource available in other forms (other sites, print, photos, etc.)
- Is the depth of information appropriate for the intended users?

The World Wide Web and the Learning Environment

The Internet can offer educators immediate access to curriculum resources, lesson plans, on-line experts, discussion groups, and teacher forums. It can provide students with resources they might not other wise have, invite higher order thinking skills, provide real-world learning experiences, and provide purposeful and motivational learning activities (Gray, 1996).

The WWW offers a variety of learning experiences for students. In this way students construct their own meaning while creating, writing, and publishing their ideas. It also provides a vehicle to distribute their work and to work collaboratively with others, including other students at remote sites and subject field experts (Carvin, 1996).

The Web also gives the learner the opportunity to experience a non-linear way of thinking and learning through hypertext/hypermedia. The work being done at Vanderbilt University in the area of cognitive flexibility strengthens our knowledge in this area and gives us guidance in the use of this new and unique learning tool that is only a click or two away.

Conclusion

Through the asking of the questions listed above when first visiting a site, an educator or learner can critically evaluate some of the information that is contained there. Both students and teachers need to be aware of the authenticity, applicability, authorship, bias, and usability of the site. The ability to critically evaluate information is an important skill in this Information Age. It is a skill that can be strengthened through continued use within all curriculum areas.

Remember that the critical evaluation of web sites can be started by looking at the top-ten-lists, sites that have been mentioned in educational journals, and those suggested by fellow educators, all followed by your own evaluation - keeping foremost in mind, the learner and the curriculum.

Online copy of this paper is available at: http://eduwww.mwsu.edu/site98/eval.htm

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Bringing Technology Tools in Line with Elementary Mathematics Curricula

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Countless teachers are facing the dual demands of incorporating into their practice both information technologies and new curricula adopted by their school systems. While in theory many teachers are open to the promise of these technologies, curricula, and accompanying pedagogies, in practice many of them are overwhelmed by the demands they place on their teaching. It is no wonder that so many fall back on drill-based computer software, which are far less insistent in requiring alterations to the transmission model of teaching. "This is so exciting. I'm loving it. I took the ideas you presented to me and we just took off on it!" (Teacher, Hanau Schools)

Teachers need support in exploiting the potential of information technology tools for specific content areas (Hawkins, 1996). This is a crucial and new development in understandings of professional development for classroom technology integration. At TERC our work in the field, in close collaboration with teachers and others in their school system, has shown that change in the way we deliver professional development is critical if technology tools are to be used to deepen and enrich student learning. Through our grounded work with particular tools and in specific content areas issues have come to the surface that before might have fallen into an undifferentiated category of "teacher resistance to change." These issues point to the importance of shaping fresh approaches to professional development, so that teachers can receive the support they need as they take steps to integrate tools and content in their teaching.

If teachers are to use information technologies to transform their practice, the professional development activities in which they take part must address what can initially appear to be competing demands of new tools and approaches. They must help teachers build a coherent vision of how to combine curricula, tools, and standards. They must be part of an ongoing process that acknowledges the gradual nature of change and that respects teachers' need to maintain control of their evolving professional goals and commitments (Grant, 1996, Little, 1993, Loucks-Horsley, 1991). And this work must be grounded in the day to day realities of teaching (Darling-Hammond, 1997). Only then will a critical mass of teachers be able to embrace new technologies enthusiastically and incorporate them into the content of their teaching in ways that deepen and enrich their students' learning.

In order to illuminate the issues that arise when technology tools are introduced alongside of a newly-adopted curriculum, and to highlight ways of addressing them, this paper will describe the evolution of professional development in three United States Department of Defense Education Activities (DoDEA) elementary and middle schools in Hanau, Germany.

I will begin to outline our efforts to prepare teachers to make discerning decisions about their use of electronic spreadsheet and graphing tools with their system's newly-adopted mathematics curriculum and beyond with a description of the Hanau Model Schools Partnership and its mathematics strand. I will lay out the philosophical underpinnings of our work with a description of the introductory workshop we have offered. I will then describe adaptations to the curriculum, which we assembled to help teachers integrate technology tools with sound mathematics. I will discuss our co-teaching model, which has made it possible to tailor follow-up support to individual teachers' and classes' needs and interests. And finally I will step up from these descriptions, which are particular to the math program, into a broader discussion of ways in which the Hanau Model Schools Partnership has designed its entire professional development plan to support teachers as they seek to introduce new technologies in ways that powerfully support teaching and learning in their schools.

Mathematics in the Hanau Model Schools Partnership

Our work with elementary mathematics has taken place in the context of the Hanau Model Schools Partnership. This National Science Foundation-funded project is a joint effort between TERC and the four schools in a K-12 complex at the United States Army Base in Hanau, Germany. The

project aims to both create broad technological access in schools and support teachers in their efforts to develop substantive connections between the technology and curriculum. The mathematics work described in this article is one part of a comprehensive research program designed to document the process of technology integration and to develop research-grounded recommendations for the field. In addition to the mathematics work described in this article, we conducted a comprehensive qualitative research study of the process of technology infusion.

A key component of the professional development work for this project has been in support of the integration of electronic graphing and spreadsheet tools in elementary mathematics. We have worked primarily with The Graph Club and The Cruncher, the recommended tools of the system's newly-adopted mathematics curriculum, MathLand. An important goal of our work has been to support use of these tools that reflect the National Council of Teachers of Mathematics Standards (NCTM, 1991) have highlighted as central to students' developing deep understandings of data collection, representation, and analysis.

The three-year Hanau Model School Partnership had its kick-off September 1995. In the first year we broke ground for the partnership, conducting a ground-level assessment, developing a planning committee, and then with them creating the two-year implementation plan for the project. During years two (1996-97) and three (1997-98) we have implemented that plan. That implementation plan spelled out the hardware, software, and connectivity plans for the four-school cluster, as well as detailing plans for an ongoing community-based group to oversee implementation, a comprehensive professional development plan (including on-site support from a curriculum-focused "educational technologist"), and a broad-based research and evaluation plan. The mathematics work described in this article is one of the pillars of the professional development work.

My mathematics work with teachers in Hanau (15 elementary and one middle school) has been a long-term process. It has included: summer workshops for participating teachers in Years Two and Three; follow-up classroom visits and consultations; focus group meetings; consultation to the on-site educational technologist, who meets periodically with the focus group; informal support through e-mail correspondence; collaborative "demonstration" and co-teaching lessons; and adaptations to the adopted curriculum. We have combined these efforts with work with professionals from all levels of the DoDEA system — principals, the school-based educational technologist, and content specialists from district and headquarters levels — to support our efforts to help teachers make discerning decisions about their use of electronic graphing tools in the classroom.

The following is a brief chronology of my work to support the technology in elementary mathematics program in the Hanau Schools:

Year One.

Needs assessment (review of the DODEA mathematics and technology programs, materials, and plans for professional development); consultation with district and headquarters math specialists); materials development (creation of MathLand Technology Framework, writing of grade-specific recommendations for tool use in elementary mathematics)

Year Two.

Introductory summer workshop; ongoing work with teachers (research and informal support, and consultation to educational technologist); piloting of co-teaching model; collection of student work

Year Three.

Continuation of above activities, including full implementation of co-teaching model; broadening teacher participation (consultation, classroom visits, after school introductory and update workshops); plans for "scaling up" of professional development approaches across Hessen district

Introducing Tools in the Context of Content and Curricula

Because electronic spreadsheet and graphing tools are fairly complex, most professional development for these tools becomes training on the software itself. Our priority, though, has been to help teachers integrate these tools into their teaching practice. Thus, even when first introducing them to the tools we have worked with mathematical activities that teachers can, with minor adaptations, bring back to their classrooms to teach beyond the tool to the content.

As we reviewed MathLand's materials in the first year of our project it became clear to us that, without substantial professional development and supporting materials, electronic spreadsheet and graphing tools might be introduced in ways that would inadvertently undercut the processes that the DoDEA curricular guides and standards, which reflect the NCTM Standards, are attempting to build. Electronic graphing tools are too often used only as a way to make quick and professional-looking charts for final presentations. Rather than enriching children's understanding of the nature of the data with which they are working, this approach reduces graphing to a mere set of efficient procedures (Ainley and Pratt, 1995, Grant, in press). And spreadsheets are too often introduced as a mere set of procedures, without applying their power in a meaningful context.

Therefore, we offered an introductory summer two-day workshop for electronic spreadsheet and graphing tools, which included a combination of tool training (with a focus on learning to use the tools themselves), exploration of the power of the tools for communicating and making sense of

data, an introduction to the application of these tools to content goals and classroom practice, within and beyond mathematics, and consideration of students' understandings through analysis of their work.

Prior to coming to the workshop many teachers had little or no exposure to spreadsheets, or to their electronic graphing capacities. Through work that went beyond "being trained to use the tools," we helped them develop understandings of ways in which spreadsheets and graphs can help describe and make inferences from data, as an integral part of a wider analytical activity. We worked with a combination of activities that were mathematically challenging to teachers, and ones that were drawn from the adopted curriculum and its accompanying software.

Teachers worked with real data (e.g., about weather patterns, modes of transportation, relative sizes of squares) as they learned the mechanics of graphing electronically. They then explored different graphing options. For example, after discussing what they thought was the intended message of a graph about the regional distribution of baseball card collectors, they used The Cruncher and Excel to alter the message of the graph, with changes in graph type, scale, and title. They used spreadsheets to extend Growing Shapes, an activity from the 5th grade curriculum that involves identifying patterns in the relative lengths of sides, perimeter, and area in squares of increasing sizes. And they worked with a spreadsheet to plan a party within a limited budget.

We used grounded examples of class investigations about topics of genuine interest, in order to communicate the power of these tools, and their potential both within and beyond the mathematics curriculum. Rather than emphasizing formulaic approaches, we stressed the capacity of these electronic tools to deal with "messy" numbers and large data sets; to do rapid calculations; and to use scale changes and a variety of graph types to provide different views of the same information.

Teachers discussed where and when within a given activity (and with which activities) electronic graphing tools might further understandings of data. As others' experience suggests (Lewis, 1997), we found that some of teachers' most powerful insights came when the sessions included the analysis of actual students' work, both hand and electronically-generated. Some of the discussions centered on what teachers might not want to lose with the introduction of electronically-generated graphs (namely multiple experiences with hand-generated graphs, both as opportunities for students to construct understandings of essential features of graphs, and as teachers' windows into their students' understandings) (Grant, in press).

Certainly teachers need to learn the mechanics of electronic graphing tools. This requires a substantial commitment of resources and time. But without opportunities to deepen their own understanding of the mathematics of data, as well as to consider use of these tools that will support efforts to make their students more critical generators and consumers of data, key components of the mathematics reform effort will be undercut by the introduction of these tools.

Adaptations to the Adopted Curriculum

The DODEA system is far from alone in working with a curriculum in which the role of technology tools is poorly conceived and articulated. As in many school curricula, technology in MathLand is an afterthought: the main curriculum refers to a different set of technology tools than the accompanying technology guide; there is no summary description of the role of the recommended tools in mathematics, or their relevance in the elementary classroom; the fit between activities and tools in the technology guide is often poor, with only occasional instances in which the activity design exploits the real power of the tools; and the activities contain no objectives for tool use. Nevertheless we felt that the mathematical tools recommended in the technology guide (The Graph Club and The Cruncher) are worth working with and building on.

At the request of teachers, we have developed an adapted suite of materials to guide the use of these tools in the MathLand curriculum and beyond. These include: 1) a general description of the function of each tool, and its potential contributions and limitations for mathematics learning in the elementary grades; 2) recommendations of exemplary activities incorporating the tools at each level, with objectives for tool use; 3) "cheat sheets" for each tool; 4) "road maps" to the key resources in the software itself (e.g., tutorials, projects), and their relationship to the curriculum; 5) further resources (recommended math web sites, articles about data investigations in other elementary schools)

These materials have helped teachers identify optimal uses of new tools in the context of their new curriculum. Yet given that both of these involve new relationships to content and pedagogical processes, a number of teachers have also requested additional, customized, in-person assistance in incorporating these tools into their regular classroom practice.

The Development of the Co-Teaching Model

Just as there is no single type of student with a suite of learning needs that is applicable to all students, any given school houses a vast array of teacher styles, experience, preferred approaches to learning, and immediate needs. In Hanau there grew a steady stream of requests from teachers for "help with managing computers in my classroom." Yet when we talked with individual teachers we found that what they meant by "management" varied greatly. Some wanted tips and actual assistance with teaching the tool itself to their students. Others wanted help designing off- and on-

computer tasks in order to make optimal use of the limited number of computers in the classroom. Some classes had done extensive work with data collection projects, but had specific technical questions to address in the context of a specific activity. Some teachers wanted help with a follow-up discussion of students' representations of their findings, both on and off computer. Still others wanted the opportunity to take stock of what they had done to date, and help with planning next steps next steps. How could all of this take place in a single workshop?

In response to this need we have developed what we are calling a co-teaching model of professional development, a planned program of optional co-teaching opportunities, planning time, and consulting designed to provide support for teachers as they encounter the challenges that come with putting into practice their evolving understandings about the use of technology to support inquiry-based learning.

Following a pilot in several classrooms in May 1997, my November 1997 visit to Hanau consisted of a full week of individualized classroom support. During that week I divided my time between the two elementary schools and the middle school, following up on requests from individual teachers. Through advance e-mail communications these teachers had chosen from among several options for my role (that of consultant/fellow-planner, that of observer/consultant, or that of co-teacher), and we had established a shared plan. Whether I took the lead or served as a background resource for work that was already in progress, I counted on teachers' playing an active role in preparation, participation, and follow-through after my departure. In addition to extending curricular links, I made a point of introducing teachers to a range of technology configurations (e.g., small groups rotating through stations that involved on- and off-computer work, students working individually or in pairs in the computer lab; using the in-focus projector in discussions).

The fact that these teachers had corresponded with me well in advance made it possible for us to collaboratively shape our time together. E-mail communications, both prior to and as a follow-up to the visit, transformed what might have been an isolated visit into a customized, shared activity that was well integrated into the ongoing work of the class.

If the elementary math work is any indication, this co-teaching offering is filling a keenly felt need. Every minute of my week was filled with work with various combinations of teachers and students, within and outside the classroom. I consulted or co-taught with 14 teachers (in one or two sessions), offered an in-service workshop to the entire faculty of one school, and met with the technical support teams, the principals, and the district math liaison, to update them on our work.

It is significant that the teachers who initiated these collaborations ranged from the technology trailblazers to the wary. This is a striking development in the educational arena, in which often it is only the innovators or early adopters who engage with technology (OTA, 1995). We are seeing teachers across the system make substantial commitments of time and energy in their efforts to integrate technology tools in their teaching.

What began as complementary support to an elementary math focus group has grown into a model for supporting the integration of technology tools in science, social studies, and language arts as well. Co-teaching weeks with five experts, coordinated to bring a cohesive approach to their offerings, have been scheduled across this third year of the project.

Conclusions

A fourth grade teacher who, last spring, had been new to the school, new to technology, and quiet in her public presence, this Fall presented her students' work to her colleagues at an inservice workshop. They had worked by hand and with the computer to represent and make sense of their findings from their survey on people's beliefs about whether animals, humans, or plants can live longest without food or water. Students had been deeply engaged in their investigations, and this teacher's colleagues expressed admiration for the quality of their work.

What, beyond this teacher's own talent for teaching and her appetite for learning, makes possible such growth? Our work on professional development with the Hanau Model Schools Partnership has pointed to the convergence of a number of key points.

In our work with teachers to answer the two critical questions, Why are you using these technologies in your classroom? and What support do you need to make the best use of these technologies to meet your instructional goals? we have emphasized how important it is for teachers to take responsibility for their own learning. Yet this responsibility cannot be exercised in a vacuum. The following are additional elements we have found crucial to professional development in the Hanau Model Schools Partnership:

1) The provision of classroom support "where you need it and when you need it," from the Educational Technologist, has provided a key link between curriculum and technology. He complements the work of the technical support staff by serving as a responsive presence who keeps in touch with teachers, supports them with the tools, and points them to possible links and extensions.
2) The selection of a common tool kit, made up of a limited yet comprehensive suite of tools that the technology and curriculum support team can "have at their fingertips" as they move in and out of work with teachers across content areas and grade levels, makes possible the kind of on-site support that is so crucial.
3) The provision of common planning time has been an important component of introductory and follow-up workshops. We brought a phased approach to planning for use of the tools in teaching with individual Technol-

ogy Action Plans (TAPS). These invited teachers to step back from their practice, consider their goals, and think about how new tools and ideas might support them. The TAPS process, which begins with making a commitment to learn something new, is stretched out over time to include tool and resource exploration, planning, test trials, and reflection. It culminates in teachers designing an extended plan for infusion of tools into specific content areas, in multiple units across the year. These TAPS have become reference points for teachers across the four schools, to which they refer often.

4) The provision of after school technology update workshops have helped carry the learning from introductory workshops into the school year. In addition to reviewing the tools and introducing new features, these give teachers a chance to address questions and needs that emerged after they had a chance to work with them in the classroom.
5) The Hanau principals have taken the role of learner alongside of their teachers, recognizing that in order to lead and support teachers they themselves need to understand what their faculty are grappling with. Through their participation they have come to understand that learning about technology takes time, energy, and risk-taking, and that they need to give their teachers room for all three.
6) Hanau teachers have become key supports to one another, whether in clusters, teams or informal groups. The fact that they are using common tools from the tool kit makes it possible for them to invite each other to try something new, pass on tips, offer a sympathetic ear when something goes wrong, and generate excitement about collaborative projects.
7) In initiating this work with technology tools, we wanted to be sure that our efforts complemented, rather than competed with, the work that was already underway in the DODEA system. Regular meetings with district and headquarters content specialists have helped to ensure that the curricular and technology goals are mutually beneficial, and have built capacity within the system to sustain long-range viability of the work.

The processes described above provide an essential backdrop for constructive professional development for technology in education. These, combined with the efforts described earlier in the paper to make meaningful links between tools and content areas, are key to a thriving professional development program for technology that is closely linked with curricular goals.

We have found that the fact that, having technology tools and technical support in place and an active e-mail culture across the schools, it has been possible to capitalize on face to face professional development opportunities for teachers. Because it is not so resource-intensive to only be within reach of wealthy school districts, this approach is usable and scalable. By leveraging resources that are already in place, it is possible for school districts to provide the kinds of support that teachers need, within the constraints of budgets and personnel.

The literature on technology in education acknowledges that ample resources need to be devoted to professional development for technology use. But that professional development musts go far beyond "training" with the goal of tool mastery. If we aim to use technology to support school reform, we need to make a concerted effort to deepen teachers' understanding of the potential and the limitations of tools in the context of specific content areas, to revise adopted curricula to reflect those understandings, to provide customized support, and to include involved parties from all levels of the system in these processes.

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Using an Interactive Multimedia Professional Development Tool to Develop an Educator's Understanding of Mathematics Teaching

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This qualitative case study investigates how one teacher used an interactive multimedia professional development program (Understanding Teaching —UT) to help learn and apply the Professional Standards for Teaching Mathematics published by the National Council of Teachers of Mathematics (NCTM). This teacher spent 14 hours using UT over the course of one school year. Pre/post-assessment data indicated that she improved in her ability to correctly identify the NCTM Professional Standards for Teaching Mathematics and in her attentiveness to mathematical discourse in the videos. Observation and interview data indicated that she incorporated new questioning strategies into her teaching practice and began trying more challenging mathematics with her students.

Professional development for practicing teachers is a topic demanding increasing attention in forums on critical issues facing education (Tally, 1995). The publication of the Curriculum and Evaluation Standards for School Mathematics (1989), and the Professional Standards for Teaching Mathematics (1991) by the National Council of Teachers of Mathematics (NCTM) created the basis for an unparalleled program of professional development in mathematics education (Aichele, 1994).

David Cohen (1991) told the story of Mrs. O, a teacher who believed that the NCTM Standards had made a change in her classroom. She had moved from teaching calculational mathematics (Thompson et al., 1994) in a traditional way to using "math manipulatives" and new activities to develop her students' mathematical understanding. But the revolution wasn't really finished. Little attention was given to the importance of students explaining mathematical ideas, i.e. engaging in mathematical discourse. Mrs. O. was not really teaching the conceptual math called for in the NCTM Standards.

This paper tells the story of Mrs. N., a teacher who, like Mrs. O., was engaged in teaching "manipulative mathematics" with her students. But Mrs. N. was able to use a tool that modeled Standards-based mathematics. The goal of this research study was to investigate how an interactive multimedia system might be used as a professional development tool to help a practicing teacher move her vision of teaching and learning toward the conceptual mathematics described in the NCTM's Professional Teaching Standards.

A Summary of Interactive Multimedia Use in Mathematics Education

Previous studies have shown the effectiveness of using interactive multimedia technology in the field of mathematics education. Goldman & Barron (1993) found that when video illustrations are used in a math methods class with pre-service teachers to demonstrate teaching techniques, these techniques are incorporated into their field experiences. Van Galen (1993) found that video vignettes of classroom situations can facilitate reflection among in-service teachers in mathematics when used as part of a course in The Netherlands led by a teacher educator. Bitter & Hatfield (1993) found that preservice students in a mathematics methods course who used an interactive multimedia system showed more appreciation for using manipulatives, demonstrated better observational power, and reported gaining a better sense of the elementary classroom. Clark (1995) evaluated an updated version of that same program and found that preservice teachers were better able to recognize, identify, and explain more of the NCTM's Professional Teaching Standards than preservice teachers who used the NCTM's text publication. Her report recommended using the same Understanding Teaching program as a professional development seminar with in-service teachers in the field. Bitter and Pryor's (1995) pilot evaluation of another updated version of this program with a group of in-service teachers indicated that it was perceived by potential users as an appropriate means of teaching the Standards. More recently, Lambdin, Duffy, & Moore (1997) found that preservice teachers in a mathematics

methods course who used an interactive multimedia product (The Strategic Teaching Framework—STF) modeled their own teaching on the examples provided in STF as well as using the videos as a basis for their own reflections. Research suggests that interactive multimedia may provide an effective means for doing professional development with teachers.

Understanding Teaching, an interactive multimedia professional development tool

Understanding Teaching: Implementing the NCTM Professional Standards for Teaching Mathematics (UT) is an interactive multimedia program on CD-ROM designed as a professional development tool to help teachers learn and implement the NCTM Professional Standards for Teaching Mathematics. Developed by Technology Based Learning and Research (TBLR) at Arizona State University, this set of four CD-ROM disks provides the user with guided observation experiences in classrooms to demonstrate the NCTM Professional Standards for Teaching Mathematics. The videotaped lessons teach concepts of geometry and numeration.

UT is composed of four learning modules: Professional Development, Teachable Moments, Application, and Assessment. In the Professional Development module, users view 46 full-motion video vignettes of approximately two to five minutes in length demonstrating each aspect of the six NCTM Professional Standards for Teaching Mathematics. In the Teachable Moments module, users practice identifying the Standards as they naturally occur in a classroom. In the Applications module, users apply their knowledge by creating a lesson plan. With the Assessment module, users view a video vignette, select all of the NCTM Standards that are shown in that vignette, write their rationales for each selection, and compare their final selections to experts.

Mrs. N. and her professional setting

Mrs. N. is a 15 year veteran of teaching who works with two classes of kindergartners every day. She is considerate of her students and brings considerable energy to the classroom. Hers is the kind of classroom one would wish for one's own kindergarten-aged child: orderly, friendly, active; a community of learners.

She had access to an Intel-based multimedia computer in her classroom as a part of the district's efforts to upgrade their technology. Her principal arranged for their participation in this research project along with other teachers in his school. He gave them professional development credit for the time they spent using UT, and hoped that they would then use UT to teach others on the staff.

Method

A qualitative case study approach was chosen for this investigation. Researchers in mathematics teaching and learning find case studies useful in understanding the complexities of practice (Lampert, 1986). Stake (1995) and others (Shulman, 1987) have noted that case studies provide particularly rich illustrations. Case study research has been critiqued for its limited scale (Bogden & Biklen, 1982), but others (Erickson, 1986; Stake, 1995; Peshkin, 1993) suggest that the depth of case study inquiry provides unique insights that are useful in other contexts.

There were three data sources for this study:

1. An instrument for assessing the participant's understanding of the NCTM Professional Standards for Teaching Mathematics before and after using UT .
2. Observations of Mrs. N. as she taught mathematics lessons and as she used UT . Lessons were observed and scripted both near the beginning of their use of UT and after their use of UT. Formal observations of their use of UT were audiotaped and transcribed.
3. Participant interviews, both individual and focus group. These interviews were audiotaped and transcribed.

The primary method of analysis used in the study was direct interpretation (Stake, 1995). Interpretive memos were written after observations, after interviews, after transcribing the interviews, and after reading documents. In this way a growing list of assertions about the case was kept. These assertions were made and then checked against other data. Evidence was sought to confirm or disconfirm assertions and further elaborate on each assertion as new data was collected. Participants were asked to confirm assertions in member checks.

Asking the Why Questions: The Case of Mrs. N.

Mrs. N.'s classroom has changed this year. She knows the Standards better as a result of using UT, and she is beginning to implement Standards-based mathematics in two ways: she is using some new questioning strategies that are enriching the mathematical discourse in her classroom, and she has introduced more challenging content into her mathematical curriculum.

Using Understanding Teaching

Mrs. N. reported using UT for 14 hours total over a period from October to April, with most sessions using UT lasted for 1 hour. Nine hours of that time was split equally between learning the Professional Standards for Teaching Mathematics in the Professional Development module and seeing those Standards applied in everyday lessons in the Teachable Moments module. She spent one hour taking the pretest, and two hours each in the Assessment and Application modules. The investigator observed Mrs. N. using UT for 2.5 hours.

In observing Mrs. N. using the UT program, one of the things that consistently preoccupied her was determining the mathematical task for the students in each segment

shown. Determining the task proved to be very difficult, not only for her but also for other teachers in the group.

Just what the students were being asked to do in each lesson interested Mrs. N. a great deal more than it did the program designers. Mrs. N. expected to learn some specific new activities to try with her students, whereas the designers thought that she would be learning a set of generic teaching techniques. When Mrs. N. visits another classroom vicariously through the video camera, she does not look first for exemplars of correct technique, but for a set of activities that she can do successfully with her students. This observation fits with Thompson et al.'s (1994) recommendation of providing a "repository of rich problems" (p. 90) for teachers to begin using with their students as a critical element in helping teachers begin to move toward conceptual mathematics.

Improved Understanding of the Professional Standards for Teaching Mathematics

In the pre-/post-assessment analysis there was further evidence that Mrs. N.'s understanding had changed through her experience with UT. After using UT, she selected 30% more of the correct Standards as defined by the experts cited in the Assessment module. More importantly, Mrs. N.'s rationales more closely resembled that of the experts. For example, before using UT she said that the teacher's role in discourse was limited to requiring the students to discuss with a partner. After UT she mentions new roles that align with notions of discourse: questions stimulate thinking, the teacher responds to what the students say, and most importantly, that the students clarified their ideas orally. This corresponds with what the experts saw in this segment. One of their stated rationales for Standard 2.1 in the same video is that "The task engages some students and had them compare answers and discuss responses." Their answers share Mrs. N.'s emphasis on the importance of the oral clarification of the student's mathematical ideas.

Changes in Teaching Practice

Using UT changed Mrs. N.'s teaching practice in two ways. She began using new questioning strategies, and she began doing more challenging mathematics with her students.

New questioning strategies. In a November interview, Mrs. N. explained how her graphing lessons were changing:

> When you first saw me graph apples I did everything. Today I had them put the cookies-they were graphing who likes cookies [for snack], who likes doughnuts-they would put the markers on the graph. Then I would ask the class, "Should it be there? Did they put it in the right place?" And then I would say to them, "How do you know?" And they would start discussing. "I think it's this," and "I think it's that," and "I don't think it's fair." Then they had to show us. Well look! They started talking and interacting. And I'm kind of out of the picture. Isn't that what I want? I want to be out of the picture. . . . You enjoy them discussing it!

Mrs. N. is not a teacher who is new to the idea of active discussion in her classroom. But what is new is the idea of active discussion in mathematics. Mrs. N. has used the Mathematics Their Way (MTW) program for a number of years in her classroom. The assumption of that program are not fully aligned with the NCTM Standards and notions of conceptual mathematics (Cohen, 1991). The "manipulative mathematics" of MTW is still focused on learning the procedures of mathematics, but by using new materials and new methods to accomplish this. The critical new element in MTW is new mathematical activities, not new mathematical discourse. This same belief was reflected in Mrs. N.'s practice, but it is changing after using UT.

In April at the conclusion of the study a final focus group interview was conducted. This gathering provided closure to the project as well as addressing concerns about the brevity of the UT videos that the teachers in the project had expressed. The participants were shown a 45 minute videotape of a teacher doing one lesson that particularly focused on demonstrating mathematical discourse. This video was made as part of the Math Discourse Project (MDP), an effort funded by the National Science Foundation aimed at better showing mathematical discourse in actual classroom lessons. After watching this video of a lesson, Mrs. N. had this to say:

> You know what she does a lot of, and its like a light going on for me. She doesn't give them paper and give them an assignment and tell them to do this. Instead she gives them a task that has a problem, and she allows the students to solve it. . . She allows them to defend their reasoning, and to show her how they arrived at their conclusion.

For Mrs. N. this video clip was much better than UT because it focused on improving mathematical discourse in the classroom. As she watched the students in the video defend their reasoning, she realized the value of having students make their thinking public. At the end of the study Mrs. N. states very clearly that she has learned new questioning strategies from UT. The key to these new questioning strategies is that they allow her to "see my student's thinking." She saw more of those new strategies in UT and the MDP video, and she began to encourage her students to defend and explain their responses in the classroom.

More challenging mathematics. There is a second and related way that Mrs. N. says that her teaching changed: she has begun teaching more challenging mathematics to her kindergartners. In November Mrs. N. and a colleague were using UT with the investigator serving as an observer. They

were watching a lesson from the Teachable Moments module. Mrs. N. was concerned whether or not second graders should even be doing long division since that content is usually reserved (in her mind) for third grade. Next she wondered if they really understood the division. The breakthrough in her own understanding came when she saw how easily division can be demonstrated using the manipulative materials. In the video, the students initially struggles with the task, but are successful with the teacher's help on the second try.

What so impressed Mrs. N. in the video is how higher level mathematical operations like division could be brought down to a primary level through the use of manipulatives. She had used manipulatives in her own classroom with her assigned content, but had not thought about how manipulatives might provide a window to more challenging content. Mrs. N. was taken with the idea of exploring more challenging mathematics with her students despite her concerns that she might be intruding into what next year's teachers cover in mathematics.

So Mrs. N. began teaching addition with regrouping to her kindergarten students in the context of a flash card racing game that they play. She and her kindergarten students were adding numbers like 38 and 14. They did this together on the board, and for some of her students it is an exercise in counting (not regrouping), but in the context of the flash card game it is something that her whole class can participate in doing.

Providing challenging mathematics activities that was "above grade level" was new to Mrs. N. She is now thinking about mathematics differently. Mrs. N. now has higher expectations for her students in mathematics, and higher expectations for herself as a facilitator of mathematical discourse. These higher expectations came through her interactions with the investigator and through her use of UT.

Discussion: UT as a Facilitator of Changed Practice

Mrs. N. knows the Standards better after using UT. The analysis of her pre- and post-assessment responses also reveals an eye that is sharper at looking for mathematical discourse. She is employing new questioning strategies and has developed higher expectations for her students' mathematical endeavors through both her conversations with the investigator and by finding examples of discourse and mathematical activities in UT.

Does the case of Mrs. N. show that interactive multimedia can provide the kind of professional development resource that can change teacher thinking and tilt their practice toward that of conceptual mathematics? The results suggest that Understanding Teaching provided the resources that helped Mrs. N. learn how to change her practice. The change in this case happened through interaction with the researcher as well as interaction with a larger group of teachers, much as van Galen et al. (1993) reported earlie

One could argue that Mrs. N. is certainly better off than most teachers for having seen examples of the Professional Standards for Teaching Mathematics. She is better off than Cohen's (1991) Mrs. O., who mistakenly believed she was teaching in accord with the Standards. Mrs. N. is at least beginning to engage in the newer forms of mathematical discourse that are critical to the NCTM Standards, and part of what helped her do this is her chance to vicariously visit the practice of other teachers through UT.

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Teachers Integrating Technology into Mathematics Instruction: Issues of Teacher Change

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There has been an increase in emphasis for using various technologies in classroom Whether the reason is giving students access to interactive learning environments, or promoting a more technological literate society, K-12 classroom implementation of technology is becoming very popular. Some of the technologies being used in classrooms are computers, calculators, videodisk players, as well as other multimedia devices.

In an analysis of policy documents, Ragsdale (1991) reports a large and growing preference for computers to be used as tools in the classroom. Policy documents in mathematics education, such as the Curriculum and Evaluation Standards [NCTM Standards] call for the integration of technology into mathematics instruction. According to the NCTM Standards "thoughtful and creative uses of technology can greatly improve both the quality of the curriculum and the quality of children's learning" (NCTM, 1989, p.18). Fagan (1996) mentions the appropriate use of technology as one of the shifts occurring in mathematics teaching and learning as reported by teachers.

Central to the integration of technology into mathematics curriculum is the question of how teachers effectively integrate it in their mathematics classrooms. Ragsdale (1991) argues that computer use as an instructional tool requires teachers to be knowledgeable users of the tool in the classroom. Certainly, for many teachers becoming knowledgeable users of technological tools for classroom use can be a new, challenging, and complex endeavor - one that involves change.

This paper focuses on gaining an understanding of the extent to which one teacher's movement in the direction of change has interacted with his commitment to using technology in his mathematics instruction. The study will document specific characteristics of this teacher and relate his experiences with a model of teacher change that I propose. The study addresses two research questions:

1. Where is this teacher located in the proposed model of teacher change?
2. To what extent does this teacher's experience follow the proposed model of teacher

In Search of An Appropriate Model of Teacher Change

What seems to be missing in this call for implementing technology into classroom instruction is a good description of the process. in particular, it would be useful to understand how teachers change as they integrate technology into mathematics instruction.

In trying to develop an appropriate model describing the change process of teachers as they integrate technology into mathematics instruction, I have considered several models related to teacher change (i.e., Guskey, 1996; Sandholtz et al., 1992; Shaw & Jakubowski, 1991), then combined parts of these models into a whole.

Movement in the direction of Change

Shaw and Jakubowski (1991) indicate the need for a mathematics teacher to have a perturbation in order to change. Perturbations cause a teacher to reflect on and question his/her classroom practices. Shaw and Jakubowski explain that without a perturbation, a mathematics teacher is satisfied with their practice. A perturbation may occur as a result of observations of one's own classroom practice, curiosity about more effective classroom practice, teacher inservice programs, and so forth. Shaw and Jakubowski discuss how perturbations result in the disruption of a mental state of equilibrium. One of three things happens:

1. a teacher blocks out the perturbation, therefore, preventing the opportunity to change;
2. a teacher develops a rationale for not dealing with the perturbation; or
3. a teacher plans to make a change.

Commitment to Change

Teachers who plan to make a change are faced with decisions about how to act upon their intent to change. They have gone beyond the perturbation state and have committed to making change. This commitment is the second requirement in Shaw and Jakubowski's (1991) process of teacher change Commitment to change can manifest itself in many different ways. For example, the teacher may collaborate with other teachers in sharing innovative ideas.

This sharing of ideas may lead to the teacher discovering alternative approaches to using technology in the mathematics classroom.

However, there exists the possibility that teachers who are committed to change do not have the support or opportunities that would allow them to discover alternatives to their existing practice. For example, a teacher with ideas about alternative approaches incorporating technology may not have access to a computer or computer lab to try ideas out In this case, it is unlikely that significant change will occur, despite the commitment to change.

Change in Practice

When teachers attempt to implement an innovation, they have to learn techniques for enhancing their instruction during the innovation. They have to find ways to use the innovation to their advantage. They have to become more focused on the effects of their teaching on students' learning of mathematics, as opposed to reflection on their own survival while teaching mathematics using technology. In short, they have to change their practice.

Once teachers decide to change their practice, they observe the effects the change has on their teaching and their students. They refine their beliefs and attitudes about the innovation. They are reflective. They are able to make decisions about whether or not to modify their practice so that significant change is made. They may abandon the new practice in favor of previous methods of teaching, if things are not working as intended. This continuous reflection may cause them to have other perturbations (Shaw & Jakubowski, 1991), hence, the process of change continues.

An Improved Model of Teacher Change

Based on existing models, and a synthesis of the literature, I propose the following model for describing the process of change teachers experience when integrating technology in mathematics curricula. The model consists of six major locations These locations are the following:

1. perturbation,
2. commitment,
3. absence of commitment,
4. attempts at changing practice
5. significant change in practice, and
6. no significant change

The model also contains intermediate locations that teachers reach before moving to one of the major locations listed above. These intermediate locations are the following:

1. teacher plans to make change
2. teacher lacks resources for discovering alternatives to current practice,
3. teacher creates his/her own alternatives to current practice,
4. teacher retains some aspects of alternative practice, and
5. teacher abandons attempted practice.

It is possible for teachers to move back and forth between the locations in the model. It is also possible that teachers would be in more than one location simultaneously.

Recall that perturbations initiate movement in the direction of change (Shaw & Jakubowski, 1991). As a result of the perturbation, two things may happen:

1. teachers may plan to make a change in their own classrooms, or
2. they may ignore the perturbation (absence of commitment).

Teachers who plan to change might develop a rationale for postponing change. Therefore, there is an absence of commitment to change here also. An absence of commitment leads to two possibilities

1. If teachers are perturbed to thinking about practice again, they may start the change process over, therefore they are back at perturbation.
2. If they ignore perturbations and are satisfied with their practice of teaching mathematics, then there will be no significant change in practice and the current practice of the teacher remains unchanged.

What are the characteristics of the teachers who plan to make change and actually commit to making the change? Teachers who make the commitment to change begin to make decisions about how to go about it. They may look to colleagues as resources for ideas to use in their classroom. They may look for opportunities to alter their existing practice through staff and professional development.

Now teachers at this stage may be ready to make an attempt at charging their practices. But what happens to the teachers lacking sufficient resources for discovering alternatives to practice? In this instance, three things may happen:

1. teachers may create their own alternatives to practice,
2. continue to plan to make change by looking for additional (opportunities to discover new ideas), or
3. develop a rationale for prolonging the situation, in which case they have lost their commitment to change, either permanently, or until they are perturbed to consider modifying their practice again.

Let us return to the teachers who make the commitment to change. Once these teachers have committed to making a change and created a vision of change in their classrooms, then they can attempt to change their practices, hence moving to the next component of the model. As they attempt changing their classroom practices, teachers compare their vision of the change with actual classroom outcomes. If they are satisfied that the change has been beneficial for them and their students, then they retain the attempted practice. Some aspects of their practice may be beneficial and some may not. In this scenario, teachers tend

to retain those aspects of the practice which are beneficial to themselves and the students, and those that are not, they abandon them. This phenomenon represents an intermediate stage in the proposed model. In an extreme case, if teachers are unsatisfied with most, if not all aspects of the attempted practice, then they abandon it. When abandonment occurs, teachers may be perturbed to examine new practices (perturbation) or they may revert to their original practice (no significant change).

It is possible that with the retention of the attempted practice, teachers may be perturbed even more to find ways of improving practice so that it will continue to benefit them and their students. Recall that one criterion for having a perturbation is observing one own actions and/or practice. Therefore, such a reflection on practice may lead to more attempts at changing practice. it is likely that significant change in practice occurs only after there has been several cycles of movement back and forth between the attempt and the perturbation components of the model. However, the validation of that component of the model goes beyond the scope of this study.

Background

The participants of this study are middle school teachers from two Midwest school districts. These teachers chose to participate in a workshop designed for teachers interested in pursuing personal knowledge of technology and mathematics, and in translating that knowledge into the classroom teaching of mathematics. Participants of the workshop were given the opportunity to become more familiar with technological tools and computer software. This paper will focus on the change experienced by one teacher, Tim, who uses technology in his mathematics instruction.

Case Study

A case study research design was used to determine further the extent to which the proposed model accurately reflects the process Tim goes through when he attempts to integrate technology into his instruction. This teacher was observed teaching a lesson involving technology during the Fall of 1997.

Data Collection and Analysis

Several instruments and documents were used to collect data in this case study. They included a personal history questionnaire, a pre-observation interview, classroom observations, and a post-observation interview. The personal history questionnaire of Tim was analyzed by identifying possible questions to ask during the pre-observation interview. During the classroom observations, I wrote comments in my notes that indicated the extent to which his plan, goals, and expectations, as stated during the pre-observation interview were met. I also took note of how technology seemed to be influencing Tim's teaching of mathematics. During the post-observation interview, I collaborated with Tim on themes that emerged during the course of the observations related to students' learning of mathematics and influence of technology on teaching mathematics. Tim and I revisited classroom events, incidents, behaviors, etc. We compared these events with Tim's intentions and expectations for the lessons as stated during the pre-observation interview. I have selected themes from the personal history questionnaire, the pre-observation interview, and the post-observation interview to discuss below.

Tim's Experience with Using Technology

Tim teaches fifth and sixth grade mathematics at an elementary school in the Midwest. He has been teaching for 20 years. He has taught mathematics for 19 of those 20 years. He has used many technologies in his classroom to teach mathematics. Such technologies include computer software programs, tool software (e.g., spreadsheet, database, and word-processing programs), calculators, the Internet, videodisks and videodisk players, and video cassette recorders. He has received formal training with technology through inservice programs within his school and school district, at professional meetings, and at a university project. He has received informal training with technology by self-instruction and demonstration by colleagues.

Tim indicated that he participates in a study group of sixth grade teachers interested in using technology in mathematics instruction. This group was put together by Tim's school district. Tim feels that he is a mentor to this group since he has been exposed to much of the technology that is fairly new to the rest of the group. Tim is also on the technology committee of his school. The committee applied for a grant to receive funding for technology. They were awarded the grant and will be receiving laptop computers, computer hardware, and computer software for use in classroom

Tim's Pre-Observation Interview

Tim indicated that he uses various computer instructional software programs with his students. One of his purposes for using instructional software is to develop his students' logical thought processes. He plans to "have students use spreadsheets so they can become comfortable with entering data. The spreadsheet activity will prepare them for a special lesson that he will teach on automobile traffic flow that relies on the use of spreadsheets. He will teach this lesson later on in the school year. He has found that in the past, it was difficult to teach students how to use spreadsheets while teaching this lesson

Tim will be teaching a multi-day activity. The activity consists of an adventure that tells a story about a man interested in purchasing a boat. The man is faced with some important decisions to make about the feasibility of making the purchase based on several factors including the cost of the boat, size of the boat's gas tank, and other key factors.

The adventure is presented to students on a videodisk Tim will have the students watch the video adventure. At the end of the adventure, challenge questions are asked and students will be required to discuss and attempt to answer those questions based on information given in the story.

Tim will make sure that students understand the challenge questions by discussing them with the class. Once he feels they understand the challenge questions, then he will divide the students into groups of 3 or 4 and ask the students to brainstorm information they should be looking for to answer the challenge questions. Then the class will watch the video adventure to allow the groups to gain as much information as possible. After watching the video for a second time, the students will return to their groups to organize and analyze the data that they obtained from the video. When the student groups realize they need more information, they will be allowed to access the videodisk to retrieve that information. Groups will eventually present their solutions to Tim, and he will further challenge them and direct them towards improving their answers.

Tim describes his roles in these situations as "receiver, challenger, redirector, and acceptor." Tim says that the goal of this adventure is not necessarily to have all the groups arrive at one correct solution. He says there are many different ways that students can arrive at a solution. Tim simply expects the groups to carefully document information given in their solution and to justify their answers.

Tim indicates that the major mathematics concepts targeted for this lesson are rates and proportions. He will teach a mini-lesson on rates to develop students' understanding so they can use the information in solving the challenge questions from the videodisk adventure. He says that his students have not typically done a lot with rates as part of the traditional school curriculum. He feels that this is a good way to introduce rates in a meaningful situation.

Tim's Post-Observation Interview

Tim felt the majority of the students picked up on the objectives of the lesson including working with rates, developing questions to ask to about the adventure, discarding unneeded information, and interacting with other students in the group. He admits some students "cruised" while other students worked much harder to give input to their groups. He coped with this by asking the students who "cruised" for information about the group's solution, rather than asking group members who significantly contributed towards coming up with a group solution. He felt that this made all students accountable for group participation.

Tim felt that for the most part, he fulfilled the roles of receiver, challenger, redirector, and acceptor as mentioned in the pre-observation interview. However, he felt some groups needed more redirection and less challenge. He says that in some cases, his students focused on aspects of the story that were neither critical nor relevant to the solution. He said that he had to redirect students so they would not spend any unnecessary time focusing on irrelevant material without telling the students a solution.

He felt that the students' solutions were less refined than previous classes for which he has taught the activity. Although he felt that a few of the groups had good solutions that were well documented and justified, he had to give certain groups, who had less refined solutions, direct hints to move them towards better solutions.

He felt that students during this lesson were presented with a situation that required open-ended thinking and problem solving. He indicated that students' ability to access information directly using a bar code reader with the videodisk technology enhanced the lesson. Student groups were given free reign to use the bar code reader to access any scenes from the adventure which provided any information they felt was relevant to solving the challenge questions. In the future Tim wants to connect the videodisk player to the computer and use computer software to allow the students to access certain scenes in the videodisk.

Tim feels that student interest and motivation would not have been the same had the technology been present. Furthermore, he believes that the quality of the solutions would not have been the same. He stated, "The technology enhanced the lesson and the lesson benefited from the technology." Tim says that he will definitely teach this lesson again. He feels that it is excellent mathematics, motivating, and fun.

Relating Tim's Experiences to a Model of Teacher Change

Tim is very reflective about his classroom practices. This is what led to him to think about how he can improve on this activity and others that he uses with students. For example, his difficulty with teaching spreadsheets during the traffic lesson has caused a perturbation for him. He has decided to change by introducing a spreadsheet activity before the students are taught the lesson on traffic flow. Another example of Tim's reflection and subsequent action is given when he observes that some of the student groups consider information that is irrelevant to the challenge questions. He felt that he had to serve as a redirector to help the students focus on relevant information.

Tim has shown his commitment to using technology in his mathematics instruction in several ways. Commitment is evident by the fact that he has looked for ways to learn how to use certain technologies. For example, he has sought training for learning how to use technology, taught himself how to use some technology, and attended professional meetings to learn more about technology use.

He has also shown his commitment to using technology by collaborating with other teachers and colleagues. For example, he serves on his school's technology committee. He also participates in a study group of teachers interested that in the classroom use of technology in mathematics instruction.

Tim's commitment to use technology in his mathematics instruction manifests itself in his willingness to attempt, refine, and retry mathematics lessons involving technology. He has looked for and continues to look for opportunities to implement technology into his mathematics instruction. One example of this is Tim's desire to use computer software to access scenes in the videodisk adventure the next time he teaches the activity. This is consistent with the notion that change is a complex, on-going process.

Hopefully Tim's experience can shed some light on how a teacher can go about changing his/her instruction. Tim's experience is only one that explores the issue. This ongoing study will explore other teachers' experiences with integrating technology into mathematics instruction. I believe that the study will further our understanding of how teachers change their practices when trying to be innovative. I also believe that by attempting to validate a model of teacher change as it relates to integrating technology into mathematics instruction, one would be able to use the proposed model to look at other innovations that are being attempted in the classroom.

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SETTING UP VIRTUAL FILMS WITH PRESERVICE TEACHERS AS A PRESERVICE TRAINING ACTIVITY: A CASE STUDY IN MATHEMATICS

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In France, as in other countries, there is a long tradition of using video in teacher education centers. (Nowadays, IUFM. University Institutes for teacher training). It is in effect possible for the trainees to observe the organization of' a classroom, the practices of expert teachers, students' activities and so on. short videos. This is in part, because they show the dynamics of pedagogical processes, the reactions of students and are adapted to the purpose of enlightening about pedagogical practices.

For example, showing different classroom sequences based on distinct learning models helps developing an understanding about ways of teaching and learning (Ara, et. al. 1996). Such pedagogical films offer an interesting support for discussion during training sessions. Other films can be used in order to train teachers to find the objectives of a sequence and to write the corresponding preparation.

Many trainers even think useful to go further and offer trainees the opportunity to create their own pedagogical films. But, going into classrooms to film sequences is a very time consuming task, that cannot he reasonably performed during preservice education. Furthermore, setting up rushes requires heavy hardware. whose access is not easy to insure, and demands specific training.

What can "new" technologies offer?

One common drawback or traditional video is it's lack of interactivity. Multimedia computers are. nowadays widely spread in the. teacher education centers, and video van be soon with personal machines and associated with other resources (text, hypertext, educational sofiware and so on). Several institutes have included interactive video (see Lamddin & al., 1997, for a review), which can be used in a more flexible way.

New software offer the opportunity to digitize video and to act up virtual films. This last task can he performed with personal computers. It is thus possible to work with several groups at the same time. But, even with the increasing possibilities of multimedia computers, filming in classrooms remains a very time-consuming activity. So it seemed to us convenient to focus on setting up existing videotapes. We provided teachers with digitized sequences and decided to train preservice teachers to the virtual setting up of them.

The Project

This project takes place at the IUFM of Cretcil (France) but takes into account ideas and resources developed in the framework of a research project about the transfer of mathematical textbooks in electronic manuals (Bruillard & Baron, 1996; Baron & Bruillard, 1996). In the following sections, we briefly describe this research project and the successive design phases of virtual pedagogical films.

Context: The electronic manual project

A research about the mutations between paper manuals and electronic books led us to design all electronic handbook of mathematics for grade 6 students, starting from an existing manual (Chapiron & al., 1996).

We had in mind not only to offer new resources to learners, but also to teachers (notably novice teachers). The teachers manual and a special booklet explained the authors' pedagogical ideas. But the painted material does not offer a clear image of what is really possible. More to the pot at, the socio-constructivist conceptions of the authors of the manual are not widely spread among French mathematical teachers. This kind of approach is therefore not straightforward for teachers who do not practice it. They may encounter many unexpected problems in installing pedagogical situations described in the textbook, because they do not know how to organize the classroom according to a constructivist view of learning and to predict classical student behavior and proposals. Thus, we decided that our prototype would also offer teachers multimedia resources helping them designing classes and coaching students.

First phase: segmenting

We filmed two different classes of students performing the same tasks in an author's classroom. These tasks were described in the mathematical textbook and chosen by tile

authors. During filming, which was continuous two main ideas were followed:

- Getting images of the teacher's instructions at each moment in order to be able to show the sequence of events;
- Collecting as many sequences as possible of six graders working, discussing or explaining to a small group or to the whole classroom.

The total duration of the rushes was about two hours and a half After a careful study of these rushes, it appeared that several different film editings could be created, according to different points of view. So, we decided to extract and digitize a set of short fragments, that could be rearranged in ninny ways. We digitized around a hundred of such fragments (between 10 and 25 seconds each) in Quicktime format. Technical and logistical considerations (keeping only high quality and relevant shots) were involved in tile choice of these sequences.

In order to identify all these elements, we chose to associate to each one a filename describing roughly its content. Working with different platforms (Macs and PC's), we limited the filename length to eight characters:

- First character: unique identifier of the task
- Second character: classroom number
- Third and fourth character: type of activity (e.g.: recall, orders issued by the teacher, individual work, collective work, explanation , discussion between students1 sharing of results, cognitive conflict.'.)
- Fifth character: number of persons involved
- Sixth character: kind of shot
- Seventh and eight character: main person involved in the sequence (teacher, student number)

These short video fragments represent specific sequences of in interaction, but the continuity is lost. We observed that viewing one of them without knowing the context is not relevant, and that we lacked good tools to navigate through a film database. Continuity had to he recreated by editing. It appeared to us that setting up such a material could he very profitable for training in two aspects; they could reflect about the logic of teachers' practice and, second, they could become familiar with the problems posed by using image processing software, which is now part of the common culture in IT,

Design Phases

Trainees were first shown the complete video. In-depth discussion was led with them about tile dynamics of what was really happening; the activities of two groups of twenty students with the same mathematics teacher were compared. It seemed interesting to ask trainees to set up video fragments using Adobe Premiere in order to illustrate key issues: the method followed by the teacher, the discussions between peers, the exchanges between groups and, notably the periods of socio-cognitive conflicts.

After a very short presentation of the software Adobe Premiere, they were asked to choose a point of view for their video editing, to find relevant video fragments and to link them to create a film.

First results

Four different groups of three preservice teachers worked on this project and two of them (the most advanced in information technology) were able to finish a first version in about Six hours, working in a very autonomous way. These two films are very different. The first one (about two minutes) focus on the teachers' role and the second one (about five minutes) on the students activities. These two videos were shown to an expert group including the four authors of the mathematical textbooks. Their reactions were neither lukewarm for the first film, sniffed with video effects, and very positive for the second one, in which they reorganized their own ideas.

We made no real formal assessment, neither have we yet shown the two films to other student teachers. But we observed that the preservice teachers wore realty engaged in this activity, and discussing with thorn convinced us that have increased their understanding both in organization of mathematical situations and in sixth graders behavior. This can be illustrated by a short example of one situation of the film.

An example

> Given a rectangle ABCD, the problem is to find another rectangle whose area is smaller and than perimeter is larger than those of rectangle ABCD.

The underlying idea of the situation is to convince students that area and perimeter do not vary in the same way. This is not easy to admit for many students, who believe that these two sizes necessarily grow at the same time. Paying attention to the drawings made by the pupils or to their gestures can give important hints about their way of reasoning.

Perspectives

Overall, less than 10 hours were necessary for two groups of preservice teachers to finish a first version of high quality. The students really produced a film; this activity has modified their representation of teaching and has increased their familiarity with IT Other groups are also finishing their own films, using the same set of video fragments with others points of view. The feasibility of our approach has thus been proven, at least for students having received a sound previous training in informatics. However, problems arose, that need considerations and might lead to further research

First, it would he necessary to improve students education in video writing, in order to obtain, better productions. This is being considered at the IUFM level. We will present these films to other preservice teachers, not

involved in this project, with a double aim: test the pedagogical relevance of these films and lead with them a general reflection on audio visual media and on film designing

Secondly, we intend to design a system aiming at facilitating the exploration of a database of video documents which should be necessary if we were to use this kind of approach on a large scale.

In this kind of project pedagogical and technical considerations are intertwined. Pedagogical ideas are constrained by the discovery of implementation needs and state of the art tools We expect, after the end of this first experimentation, to have a better insight in the problems fled to setting up virtual films in order to train teachers. What is at slake is developing, in a constructivist perspective activities of production in teacher education.

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Technology as a Unifying Theme in a Transdisciplinary Teacher Education Program

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Teacher education is currently undergoing some marked shifts in "personality". Two of the more noticeable to the casual observer (and not so casual researcher) are the increased emphasis upon "field-basing the courses" and in providing "rich and personally meaningful contexts for learning" And although each of these directions are worthy of following, the question of whether both can be traveled simultaneously remains open. In fact, such very basic questions as what constitutes effective methods instruction in the light of these, and other, new emphasis are up for grabs.

Regardless of which of the many "buzz-words" are used to describe the evolving teacher education programs which arise to address these concerns (and indeed, the acronyms constructed to describe these programs - we operated under the umbrella of the University of Houston's nationally recognized PUMA program, Pedagogy for Urban Multi-Cultural Action for those who just had to know!) there are some common elements which must be addressed.

Common to many of these approaches, however, are two elements - a) site basing the methods course itself. This is done most often to take advantage of the authentic context of the school itself and the expanded opportunities this allows; and b) encouraging a more collaborative approach toward the instruction of methods courses to allow for multiple contents to be simultaneously presented.

Discussion of Trans-PUMA

To this point, a reform effort in teacher education will typically take one of these two broad approaches - site basing and increasing the collaborative foci. It must be noted that this approach has certainly lead to the development of many worthy programs and arguably has improved the instruction and caliber of the teachers which participate in such programs. And yet, there has always remained the feeling that more could be done.

In the spirit of "We want our cake and we will eat it too" the four of us decided to pilot a program which would do both - be totally field based and rely upon an intensive shared collaborative effort in content methods instruction. Finding the term collaborative an inappropriate fit given the intensive nature of the collaborative effort, we have adopted the term transdisciplinary following a review of the literature. The transdisciplinary metaphor with its emphasis upon authentic problem contexts, multiple embedded problems naturally arising from these contexts, and multiple domain specific approaches which may be used in addressing these problems does a much better job in capturing the look and feel of the methods courses which we co-teach.

Early steps along this line were taken in the 1996-1997 school year when the four of us had the opportunity of co-teaching our methods courses in a field based setting. This co-teaching was extensive and involved the four of us working and teaching together for a full day a week. These sessions were intensive and challenged each of us to the limits as we determined what constituted a "good fit" for our own respective area of emphasis (which for the record are: a) Connell - Mathematics; b) Kemper - Science; c) White - Social Studies; and d) Williams - Literacy, Language Arts, and Reading). Finding this fit within the transdisciplinary methods course we advocated required continuous energy and focus. It must be noted that this was a true pilot in that there were many rough edges which needed to be worked out. As we will describe in the following section, however, we managed to work through many of the toughest ones. Based upon this year-long experience, we are now in our second year utilizing this approach.

Keeping the "dance" in the "trans-"

Although affect is not always thought of in terms of a professor variable in evaluating such programs, it must be mentioned here. It is a truly a tribute to the friendships and professional respect which we had for each other (and which was strengthened greatly as a result of this experi-

ence), that in each case where problems might have caused the whole enterprise to collapse we were able to come to a workable accommodation. Furthermore, this did not require any of us to lower either our standards or to abandon our beliefs. But rather, reflected the content expectations we are responsible for, the needs of the student candidates, and our own abilities as methods professors.

In the process of working together, there was much redefinition of our core courses for the teacher education program. This was due in no small measure to the opportunity which we have had to work together for extended periods. This alone is a positive outcome of the program, as it has enabled each of us to learn from the others and to see much better "hooks" into the respective content areas which we may utilize in our own instruction.

As might be expected, it has also lead to some very significant observations concerning ways in which our respective contents truly overlap in a natural fashion. From this ongoing interaction there have been major changes in the structure and method of teaching the methods - in this case the core courses of mathematics, science, social studies, and language arts. We feel that although there is still much progress to be made, we are approaching one protocol which is both doable for us and transferable to other settings.

As you might expect, there were many opportunities for the project's self-destruction. Such challenges are inherent in nearly any radically different approach, and we had gone into the pilot expecting them. We found, however, that despite the seeming differences (which are often due to matters of form and not substance) there were more powerful commonalties which united us and helped ensure the project's continuance.

Taking the liberty of speaking for just a moment with a singular "mathematics education voice", Connell and Bouniaev (1997) suggest that in current educational research there has been quite a bit of the paradigm wars lately. It almost seems that in the "your paradigm" vs. "my paradigm" schism that the learner and the teacher - two key groups in educational settings to say the least - are often left by the wayside in the interests of theoretical "purity".

This is a quite unfortunate state of affairs because occasionally, upon a critical examination of exactly what is to be done in actually implementing specific instructional implications, the actual recommendations for actions are quite similar. Although by their very nature education research, and researchers, must ground their work firmly within a specific theoretical orientation, typical classroom teachers are less concerned with theoretical purity then they are efficacy of results. If we are to make our research more useful we must on occasion set aside what divides us theoretically and look toward what unites us in the actions which we would propose.

In our transdisciplinary efforts we had the added benefit, however, of sharing a strong commitment to the constructivist stance and the associated implications this holds toward our content areas. Speaking for myself at this point (Connell), I would suggest that this combination of mutual respect and shared philosophy did a great deal toward smoothing out the rough edges.

The shared constructivist stance, however, makes for a few interesting problematics for us. The first, and most immediately relevant to this paper is that it makes a description (at least in a typical prescriptive and pre-scripted fashion) of the day to day structure of our combined course (formerly the four separate methods courses) difficult. You see, a primary difficulty in describing constructivist classrooms is that the teachers within these classrooms tend to be natural "constructivists" themselves. As a result, their constructivist approaches and methods are often created dynamically from day to day practice.

These methods and approaches often tend to be idiosyncratic, highly influenced by personal experience, fluid and often share only the constructivist label when compared with other "constructivist" classrooms. Now, imagine taking four such constructivists and putting them in the same classroom for, in many cases, two full days per week. It is little wonder that the term transdisicplinary mentally morphed to "Trance-disciplinary" by the end of the year.

Technology

Yet, in addition to the near Zen-like uniting and dividing which the constructivist stance offered us, there was an additional unifying force. This lay in the incredibly powerful unifying force which technology can be in such a transdisciplinary effort.

Some of this is reflected in last year's editorial comments within this very text (Connell, Williams, & Gannon, 1997). As was noted at the time, within mathematics education the process strands of the NCTM 1989 Standards for Curriculum and Evaluation describe mathematics as consisting of problem solving, communication, reasoning, and building connections. Furthermore, the case was presented at this time that the papers describing technology within mathematics education could likewise be organized around similar themes.

Well, although this is the mathematics section of the annual, it must be confessed that these process strands are certainly present in each of the other disciplines we respectively represented in our approaches. Furthermore, technology has proven itself to be the nearly universal tool of choice to use in developing these foundational skills.

And if last years experience in reading the SITE Annual is any guide, this volume (which you are now reading) will contain numerous approaches and suggestions appropriate for field basing and for a transdisciplinary and constructivist

approach. Take these suggestions and use them as a starting point. After all, we did!

Reality Checks and Recommendations

Lest one get the impression that we have achieved some type of Nirvana here in Houston, there are some difficulties which still must be fully addressed if we are to achieve the full benefits which we feel this approach affords us. And, just as technology serves as a powerful unifying agent, it can also is a source of many difficulties.

The site-basing of the methods course causes the necessity to revisit some old issues. The first, was the platform issue. Most schools have settled for one flavor or another of computers by now - due to simple logistics in most cases. Based upon our experience we find that university professors show much more variety. Despite being affiliated with the same university, our computer platform of preferences were different. To be blunt, although we would all do windows there was not consensus as to whether they were of the "95" or the "Mac" variety. For others attempting to follow our example, this is a problem which will be more on the university side than the school site.

A rather interesting situation can also develop concerning maintenance of the computers themselves. Since the computers are neither housed at the university, nor belonging to the schools, just exactly who and how maintains them can be a bit problematic. This came to haunt us as our site-based computer went down in the first week of this year and is yet to be replaced. Were it not for the presence of our supporting notebook computers the technological aspects of this project would have had to have been scrapped.

An additional requirement which we quickly became aware of was the need for notebook computers to support our work. Although not essential, to be used in a transdisciplinary fashion it is certainly helpful to have your computer mobile. Our class has met in multiple locations including: museums, zoos, classrooms, meeting halls, traditional university classrooms, and parking lots. The ability to have a constant set of technological tools and resources, despite the location, has proved to be tremendous benefit.

Another recommendation which we might offer is the need for a reliable internet service provider. We were highly fortunate in that our on-site classroom had an analog phone line. But, quite often the site based classrooms do not come equipped with a T-1 line, nor in many cases even an analog phone line for a modem connect. It seems that the schools locally will occasionally offer a phone in each classroom, but in most cases it is digital. A simple precaution, here. I have heard of quite a few folk whose modems have bit the dust because they were told, "Sure we have phone lines in each classroom". Which was true, but they happened to be the wrong type.

We have found software programs which allow you to "download" websites together with their associated graphics and links are an invaluable resource in meeting the needs identified in the preceding two paragraphs. Having the NCTM site "in the can", as it were, made the linked thinking surrounding the standards and their implementation immediately applicable in the field.

Concluding Thoughts.

The only problem with wanting your cake and eating it too is that you surely end up with a lot of cake. There were times when each of us felt overwhelmed by the work to be done, the time commitment, and the challenges. Would we do it again? Certainly. We are continuing and have plans to keep doing so. Have we came up with a set of easy recommendations for simple adoption? No, because the task is fluid and must reflect the local variable of the site and personalities involved.

We are, however, much closer to providing a "look and feel" description for others. First, start with people you like. This may seem trite, but it is very true. Second, try to find some unifying philosophical themes around which you have agreement. It is tough enough to make the content areas fit, without having to align your underlying motivations and guiding precepts. Third, technology is essential. We finally have a set of transdisciplinary "soft" tools supporting the transdisciplinary methods we have been developing.

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Teachers and Technology: Pre-Service Training for Secondary Mathematics Teachers

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Since 1989 there has been a statutory curriculum in schools in both England and Wales. The curriculum for mathemat ics has been revised twice, with each new version requiring teachers to use information technology (IT) with students in mathematics. In the first two versions (Department of Education and Science [DES], 1989b, 1991), the statutory requirements for secondary pupils (age 12-16) included the use of Computers to: generate and transform 2-D shapes, devise instructions to produce desired shapes and paths; and explore number patterns with a computer (DES, l991) The other limited references to IT always provided en alternative. For example, generate trigonometric functions using a calculator or computer (DES, 1989b, 1991). The most recent version (Department for Education and Employment, [DEE] 1995b) has a general requirement that "Pupils should be given opportunities where appropriate to develop and apply their information capability in their study of mathematics". Specifically at the secondary level. Pupils should be given' opportunities to: use calculators and computer software for number related work; use computers to generate and transform graphic images and to solve problems; and use computers as a source of large samples, a tool for exploring graphical representations, and as a means to simulate events.

The Use of IT in. School Mathematics

In the ImpacT study (Watson, 1993, cited in Johnson, Cox & Watson, 1994) positive learning effects attributed to the use of IT in mathematics were found, however a minimum threshold of IT access, experience and use was required for these effects to be measurable. The study also reported on heightened pupils' interest and enjoyment and increased subject status. More recently Denning (1997) reports on the motivational effects of IT use in school, provided the activities are purposeful, meaningful and challenging.

Where computers are used in mathematics in England and Wales, there is evidence to suggest that it is more likely to be used by pupils aged 12 - 14 than by pupi1s aged 15 - 16 (Harris & Preston, 1993; Miller, Eagle, Gough & Johnson, 1996). Typical "High" use is likely to consist of several hours of Logo. spreadsheets and graph plotting software as well as use of a number of special use short programs (Miler, 1997).

In practice there is a wide variation in the use of IT in mathematics lessons. Jared (1995), for example, notes the wide recognition of the relative neglect or the use of IT in mathematics, a view confirmed by Andrews (1997). In the survey by Denning (1997) the vast majority of teachers indicated they seldom or never, used computerw with pupils. This finding is similar to the case in France where Artigue (1998) reports "even in the many schools now provided with quality equipment, the use of computers for mathematics teaching; remains marginal".

Factors Affecting IT Use in Schools

In our view the major factors include: the statutory requirements set out in the national curriculum, the beliefs and attitudes or teachers: their IT related pedogogical knowledge and skills; and access to and quality of equipment

Statutory Requirements. As Andrews (1997) points out the wording of the statutory curriculum 'has been sufficiently general for teachers to exploit whatever software has been available. This undoubtedly helped some teachers increase their use of IT in lessons However, the limited requirements of the first two versions also helped teachers avoid using IT. Often the requirements were fulfilled in general IT lessons taken by IT specialists.

Beliefs and attitudes. Veen (1993) comments on how teachers' strongly held beliefs about content and pedagogy are slow to change. In a latter study, Andrews (1997) notes that many teachers are unconvinced of the need to use IT in mathematics, and that the mathematics schemes they use to little to dissuade teachers from this belief. Fullan (1992) also suggests that teachers' beliefs and attitudes regarding the use of IT are difficult to change.

The IT Related Pedagogical Knowledge and Skills. It is widely recognized that teacher skills to exploit IT need to be developed (for example, Oliver, 1994). The DEE survey of schools (1997d), reported in DfEE (1997c), reveals a decline in both primary and secondary teachers fully confident to teach using information and communications technology (ICT).

New teachers' IT skills are increasing, but Downes (1993), who looked at a number of studies undertaken in the UK and the US, comments "beginning teachers use computers in their classrooms much less than would expected given the increasing competence and confidence rate of recent graduates".

Access to and Quality of Equipment. DfEE (1997c) reports on the findings of DfEE (1997c & 1997d) stating that the two reports "revealed significant problems in terms of the age of ICT equipment. the availability of software directly related to the curriculum, and the confidence of teaching staff in the use of ICT to teach.

Preservice Teacher Education and IT: Statutory' Requirements

In 1989 a statutory requirement was placed on all courses of preservice teacher education in England and Wales (DES, 1989a). For IT:

> On completion of their courses, all students should be able to select and make appropriate use of a range of equipment and resources to promote learning in particular, all courses should contain compulsory and clearly identifiable elements which enable students to make effective use or IT in the classroom and provide a sound basis for their subsequent development in this field. They should be trained to he able to: i) make confident use of a range of software packages and IT devices appropriate to their subject specialization and age range; ii) review critically the relevance of software packages and IT devices to their specialization and age range and judge the potential value of these in classroom use; iii) make constructive use of IT in their teaching and in particular prepare and put into effect schemes of work incorporating appropriate uses of IT; and iv) evaluate the ways in which the use of IT changes the nature of teaching and learning.

A new document (Department for Education [DFE], 1992) changed the emphasis, so that all requirements were stated in terms of 'competence expected of newly qualified teachers'. The IT section stated: 'Newly qualified teachers should be able to demonstrate ability to select and use appropriate resources including Information Technology.

The election of a new UK Government in 1997 resulted in a new document (DfEE, 1997e) with the following requirement:

> For all courses, those awarded Qualified Teacher Status must when assessed demonstrate that they have a working knowledge of information technology (IT) to a degree equivalent to Level 8 in the National Curriculum for pupils and understand the contribution that IT makes to their specialist subject(s).

This comes into operation in September 1998. The standard equivalent to Level 8 (found in DfEE, 1995a) is:

> Pupils select the appropriate IT facilities for specific tasks, taking into account ease of use and suitability for purpose They design and implement systems for others to use. They design successful means of capturing and, if necessary preparing information for computer processing. When assembling devices that respond to data from sensors, they describe how feedback might improve the performance of the system. They discuss in an informed way, the social, economic, ethical and moral issues raised by IT.

The control element does not apply to mathematics.

In the two consultation papers, Excellence in Schools (1997a) and the National Grid for Learning (1997c), the UK Government indicates clearly the priority it attaches to the use of IT by teachers. The former looks to the improvement of education in general and the latter to the creation of a national network for ICT

Preservice Teacher Education and IT: A Research Proposal

A number of studies report the wide variation in prior computer experiences of entrants to preservice courses (for example, Mellar and Jackson, 1994), with increasingly fewer students starting with not previous IT experience (Lienard, 1995). In addition, there is an increase with time in computer useage and experience of use as pupils in schools, for the under 25 age group, as well as an increase in the importance attached to most IT training priorities (Mellar & Jackson, 1994).

Following work on children's learning using portable computers, Gardner, Morrison, Jarman, Reilly, & McNally (1992) suggest that teachers should be encouraged to equip themselves with portables in order to develop their IT skills and their subsequent IT-related classroom practice. Downes (1993) suggest that encouraging teachers to own a personal computer may prove a long term benefit to the profession.

A number of studies look at the effect of the subject department on the use of IT by trainees. Downes (1993) finds that the key factor for influencing classroom use of computers is the supervising teacher's use. Easdown (1994) and Barton (1996) identify the importance of attitude and practice of the subject department in the teaching practice

school in determining IT use during teaching practice. Byard (1995) finds a high correlation, at the 1% level for mathematics between students' use of IT and that of their supervising teachers (mentors) and, at the 5% level for mathematics, a correlation between IT confidence and the use on teaching practices. Though more generally Barton (1996) comments "It would seem that previous IT experience and even good support for personal IT skills are not sufficient to overcome the effect of a department which makes little of no use of IT their teaching. This is in keeping with the general findings of Byard (1995).

The partnership nature of preservice training in England and Wales, where trainees must spend 24 weeks of a 36 week course in schools, places a considerable responsibility for training on supervising teachers (mentors). In IT terms, Collison and Murray (1995) found little evidence that teachers are able to act as effective mentors.

The Keele Mathematics IT Course: A way forward?

Course Principles

The Keele University Department of Education has adopted a pattern for ICT education for those undertaking preservice training which is set firmly in the subject contexts. This decision has been informed by a number of concerns: providing a purposeful and realistic context for ICT learning, using subject pedagogy as the framework of ICT skills development, building on existing knowledge, recognizing the importance of accommodating subject diversity, and using subject tutors as role models.

The importance of locating the development and acquisition of IT skills, knowledge and understanding in a setting which the learner identifies as purposeful and realistic is well documented and often offered to those in preservice training as a cornerstone of good practice. A range of studies (for example, Oliver, 1994) have explored this issue and all draw attention to the need to translate this principle into the everyday practice of teacher trainers.

The importance of pedagogy

The importance of pedagogy as a key component of the rationale for requiring ICT capability in those undergoing preservice training has been given further substance by the recent work of the Teacher Training Agency (TTA) in the UK. This seeks to set out a national curriculum in ICT for students engaged in preservice training courses, and in the early drafts currently available gives prominence to pedagogical knowledge as the basis for the effective development of ICT to support teaching and learning.

The impact of student perceptions of "subject culture" is discussed by McMahon and Gardner (1995), who draw attention to the powerful influence exerted by the attitudes and practices of lecturer's and other professionals. Students are quick to adopt the current climate of opinion about the role of new technologies that they see exemplified by their own subject teachers. This view is reinforced by Waggoner (1994) in a paper which sets out a comprehensive model for the interplay between "faculty assumptions about students, faculty beliefs/perceptions about technology, environmental context, and preparation and experiences as a teacher." This concern is also raised by Easdown (1994) in a steady which explores the relationship between the staff in school who provide support teachers in training - mentors - and the beginning teachers in their care. Both of these studies reinforced the importance of the attitudes of trainers towards the new technologies as key influences on those being trained.

Background activity

Over the last four years, the tutors have tried to address the combined problems of IT competence and pedagogical knowledge of teachers in partnership schools by providing a rolling program of three-day inservice courses, where teachers are asked complete certain tasks between course days. This approach, advocated by Robinson: "In the context of information technology, in-service education of teachers must go alongside the preservice education students entrusted to teachers." The training has been offered to all teachers in partnership schools. It has met with some success: teachers have started to use IT with pupils, but usually only to a limited extent.

In addition, the department purchased four notebook computers, which were used in 1993-1996 by students in IT specific training workshops, in general pedagogic sessions, at home and in classrooms. This did improve the overall used by students of IT in schools, but there was still a small number of students who did not use any IT in the school. Four new notebook are available beginning in 1997.

Course design

There are seven features of the course: Enculturalization, Acclimatization, Integration, Differentiation, Teamwork, Confidence, and Assessment.

Enculturalization

IT is embedded into the culture of course; an audit of IT experiences undertaken before the course starts; course members are made aware of the importance of IT and, where knowledge is limited, advised to begin acquiring skills; special compulsory subject specific IT courses run throughout the period of training, there are several classroom experiences; access to facilities is provided both in the training institution and teaching placements schools; and finally, the institution has part-financed special arrangements so that all course members have access to email and the Internet while on their school placements.

Acclimatization

There is an initial early experience of IT use with primary age pupils, followed by a requirement to use and evaluate an IT activity in school using a notebook computer

with a small group of pupils. Finally, group and class activities follow.

Integration

The IT course is delivered by mathematics tutors in both the pedagogical course and in subject specific IT workshops.

Differentiated Provision

It is recognized there will be considerable differences in pre-course IT experiences. Activities take this into account following the initial audit.

Teamwork

Groups are encouraged to learn together, this is further reinforced by the requirement to produce collective products for used by pupils and future course members.

Confidence Building

Peer group support is encouraged and expected; positive experiences are shared so that all are involved as teachers and learners.

Assessment

The IT element is formally assessed. Some parts are indirectly assessed, since all course members have to communicate with tutors by email and all assignments at the word processed and spell-checked. The assessment of other knowledge and skills involves specific tasks, for example, to design in produce a poster with the aim of generating interest in mathematics, so that it includes at least one picture and a text extract downloaded from the Internet. This then has to be used with pupils.

The success, or otherwise, of this course, will be reported in a further paper.

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On the Use of Technology for Mathematics at Secondary Schools

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The purpose of this study is to examine the use of computing technology in secondary school mathematics, particularly in the probability and statistics curriculum. In recent years, secondary mathematics reform has called for inclusion of probability and statistics into high school curriculum. The recommendation made by the National Council of Teachers of Mathematics (NCTM, 1989) for secondary schools stated that "Collecting, representing, and processing data are activities of major importance to contemporary society", "Statistical data summaries and inferences appear more frequently in the work and everyday lives of people than any other form of mathematical analysis". Experience with probability and statistics activities can enhance student understanding of likelihood of uncertain events and to reason and communicate about statistical claims made by others. In order to examine the progress of the current reform effort of statistics and probability curriculum at secondary schools, Lee and St. John (1997) investigated mathematics department chairpersons' beliefs about probability and statistics, and the difficulties encountered in the implementation of the curriculum. That study found that two of the major reasons of offering little or no statistics and probability curriculum were directly related to computing technology. This study investigates the availability of computing technology for mathematics, probability and statistics, and how computers and calculators were used for mathematics instruction.

Probability and statistics , traditionally learned with a lecture and note taking approach, is often considered a boring and difficult subject. Recent research efforts suggest that many students learn best by constructing the knowledge themselves (e.g., Garfield, 1995) There have been many efforts by mathematics and statistics educators to rethink this curriculum and to develop innovative strategies and instructional material to teach statistics and probability concepts (e.g., the Quantitative Literacy Project endorsed and designed by the American Statistical Association and the National Council of Teachers of Mathematics since 1984; see also Hogg, 1992; Cobb and Moore, 1997). These innovative strategies and material are designed to take the advantage of computing technology, in particular, personal computers and graphing calculators. It is, now, accepted that statistics and probability should be delivered using activities in a cooperative learning environment (e.g., Moore, 1997; Lee, 1997).

At the collegiate level, there have been studies to investigate the effectiveness of computing technology for teaching and learning probability and statistics (e.g., Snell and Peterson, 1992; Tijms, 1992; Tanis, 1992; Fetta, 1992). Snell and Peterson (1992) identified three broad areas in which computing technology is helpful: reducing the need for lengthy manual computation, exploring graphical data analysis, and illustrating concepts using computer simulation experiments. Little attention has been paid to these issues at the K-12 level. Watkins, Burrill, Landwehr and Scheaffer (1992) discussed in length the concerns of secondary students and teachers. The use of computing technology in instruction was addressed. An understanding of the availability of computing technology and how these tools are used in mathematics, probability and statistics instruction will provide researchers and educators important information for designing innovative strategies and instructional material for both inservice and preservice secondary mathematics teachers.

Methodology

A questionnaire was developed and sent to the mathematics department chairpersons of the secondary schools in the entire state of Michigan. A total of 334 out of 809 chairpersons returned the survey. Background information included school size (classified as small (1-499), middle (500-1000) and large (1000 or more) schools), school setting (rural and urban), school type (private, public), etc. The items related to computing technology included (a) reasons of offering little or no statistics and probability, (b) six items on the availability and the status of computer technology, (c) eleven items on how computer was used in eleven commonly covered topics in an introductory

statistics and probability curriculum, and (d) eight items on the use of calculators in mathematics, statistics and probability curriculum. The data were processed and analyzed using SPSS/PC statistical software.

Results

Among the 334 responded chairpersons, 54 of them indicated they offered little or no statistics and probability in their high school mathematics curriculum. Their reasons for offering little or no statistics and probability were the following: Do not have enough time (78% chose it), Do not have enough training in computer and software (67%), High school curriculum does not require it (65%), Student background is not adequate (31%), Adequate technology is not available (29%), Do not have enough expertise (27%), and Do not need for high school students (15%). It indicates that computing technology and training are two major obstacles for inclusion of statistics and probability curriculum.

The Availability and Usage of Computers

About 56% of chairpersons responding reported having more than 30 computers, there were about every 2 in 10 schools reporting less than 20 computers available for students. Sixty seven percent of the responding chairpersons said there were computers available on the daily basis, but only 18% used them once or more per week in mathematics classes, while 24% used them in probability and statistics courses. Use of computer for homework was even more rare (15%). The results are summarized in Table 1.

Comparison of Demographics for the Availability and Usage of Computers

Demographic: Schools Offered Probability and Statistics Vs. Schools Offered Little or no Probability and Statistics. Table 1 summarizes the number of schools and the corresponding percentages within each demographic category, and the p-values of the Chi-square tests. It clearly indicated that the availability and usage of computers were significantly different between schools offered probability and statistics curriculum and schools offered little or no such curriculum. A significantly higher percentage of schools offered probability and statistics curriculum tended to have more computers available for students, for teaching aides, and assigning homework using computers.

Demographic: School Size. The comparison of the availability and usage of computers among three school sizes (1-499, 500-999, 1000 or more) is summarized in Table 2. Chi-square test was conducted to make the comparison. As expected, the larger the schools the more the computers were (p-value = .000). However, we did not find significant difference among school sizes for the availability of computers for daily basis, neither for using as teaching aides. In fact, higher percent of chairpersons from small schools responded they had computers as teaching aides than larger schools (72% Vs. 65%). When asked about the assignments using computers and teaching probability and statistics using computers, larger schools had significantly higher percentages.

Table 1.
A Comparison Between Schools With and Without Probability & Statistics Curriculum for the Availability and Usage of Computers in Teaching Secondary Mathematics.

Table 2.
A comparison among different sizes of schools for the availability and usage of computers in teaching secondary mathematics.

Demographic: School Setting. Schools were classified as rural and suburban school settings. The comparison between rural and suburban schools is summarized in Table 3. We found that the availability and usage of computers between rural and suburban schools did not indicate any significant difference, even for the number of computers available to students.

Computer Usage for Teaching Probability and Statistics

Activity-based approaches have been well accepted by educators for teaching statistics and probability. These methods rely heavily upon computing technology. Table 4 summarizes the percentages of responded schools using computers for teaching different topics of probability and

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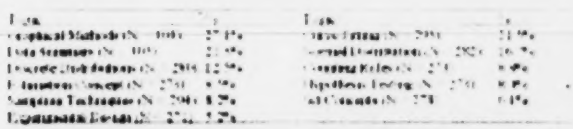
statistics. We found that less than 10% of mathematics departments used computers to teach most of statistics and probability topics except data summary (21%), graphical methods (27%), curve fitting (21%) and normal distribution (17%). The availability and the usage of computer for mathematics, statistics and probability courses in this survey indicated that the computer technology was not yet common in the secondary mathematics departments in Michigan. One major reason was the lack of training in computers for the inservice teachers. The implementation of innovative curriculum using technology has a long way to go in secondary schools.

Table 3.
A comparison between rural and suburban schools for the availability and usage of computers in teaching secondary mathematics.

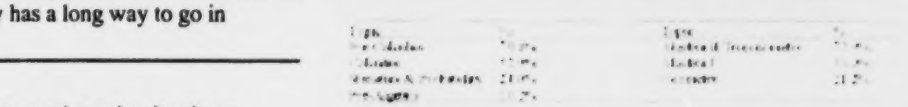
Table 4.
Summary of the proportion of responded schools using computer in teaching each of the probability and statistics topics.



The Usage of Graphing Calculators for Mathematics Instruction

As expected, the most common computing technology used at secondary schools for mathematics instruction is calculators, both scientific and graphing calculators. In our study, we found that 99% of the responded chairpersons said they used calculators as part of their mathematics instruction, and 83% indicated using calculators for teaching probability and statistics. The most common type of calculators used, in sequence, were scientific calculators (51%), graphing calculators (41%) and four function calculators (8%). When the use of graphing calculators was examined for different mathematics courses, the following summarizes the chairpersons' response, in sequence: Pre-calculus (79%), Algebra II/Trigonometry (73%), Calculus (53%), Algebra I (33%), Probability and Statistics (24%), Geometry (21%),and Pre-Algebra (10%) (See Table 5).

Table 5.
Summary of the proportion of responded schools using graphing calculators in teaching each of the mathematics topics (N = 325).



Discussion

Although the idea that students learn the best by actively participating in a cooperative learning environment to construct knowledge themselves may have been well accepted by educators and teachers, the findings of this study indicated that there is still a huge gap between the ideal situation and reality. This is particularly clear for probability and statistics. Neither personal computers nor graphing calculators were used extensively for probability and statistics (only 24% indicated using computers and 24% using graphing calculators for probability and statistics instruction). In contrast, Weiss (1995) gave a report on K-12 mathematics teachers' response to the reform agenda. In this report, over 95% of surveyed secondary mathematics teachers indicated that emphasizing on solving real problems, applications of mathematics in daily life and mathematics reasoning were important part of mathematics instruction, and 81% indicated the use of computers was important. When asked if they were qualified to teach various of mathematics subjects, only about 3 out of 10 high school mathematics teachers felt well qualified to teach probability and statistics. It is clear that high school teachers realized the importance of integrating real applications into mathematics curriculum and understand the importance of computing technology for making this curriculum possible. The curriculum of integrating real problems into probability and statistics with the help of computing technology should become the norm for both secondary and collegiate levels. This study and the results by Weiss (1995) suggest that there is a great need for improvement on computing technology, training and content knowledge for the probability and statistics curriculum at the secondary level.

Those interested in mathematics education in high schools should help secondary in service and pre-service teachers learn and implement innovative curriculum in probability and statistics. More efforts should be made by mathematics and statistics educators to provide guidance for topic selection and for development of adequate classroom activities as well as training so that teachers can utilize up-to-date technology.

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NEW MEDIA

Section Editors:
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It is always exciting and invigorating to read articles about the latest research and methodologies in the use and development of multimedia and hypermediain educational settings. This section describes a wide variety of projects which are rapidly expanding the ways we understand, manage and disseminate the information that contributes to both our teaching and learning. There are six main areas this year, and each presents descriptions of unique applications of new technologies.

Mutlimedia and Learning

Two papers explore how multimedia and new technologies have changed the ways we teach and learn. Cohen explores several issues of multimedia development as they relate to teacher education. Her paper examines the potentially negative attributes of new technological media as well as the attributes of multimedia that affect cognition such as visual literacy, multi-sensory learning, non-linear learning, self-paced instruction and individualized instruction.Cohen emphasizes the need for those who train teachers to examine many of the hidden attributes of technology that affect the process of learning.

Putnik discusses issues about the relationship of education and multimedia technology, and examines the relationship between the human learning process and educational multimedia. He emphasizes the need to motivate and challenge the learner with authentic and relevant learning activities.

Developing Multimedia Materials

Two papers describe the development of multimedia software by graduate students in teacher education programs. The authors emphasize the critical skills that are developed by designing and developing educational multimedia materials. Using a case study methodology, Lee analyzes the factors in hypermedia learning. This study describes how a hypermedia was designed by incorporating important learning factors. First, students were given increasingly challenging exercises to enhance computer skills. In addition, students were allowed both the time to learn and progression from basic to more difficult skills. Finally, Lee states that repeated success throughout the entire leaning process was a critical factor. This case study also presents student responses to a questionnaire that inquired reactions toward those factors.

Shopland and Kannegieser suggest that undergraduate and graduate teacher education students who have engaged in the process of designing and developing instructional materials are better equipped to evaluate commercially prepared instructional materials and match these materials with individual learning styles and needs. They believe the development of multimedia instructional materials is an essential precursor to effective and meaningful evaluation of the wide range of multimedia software available to teachers. In addition, Shopland and Kannegieser state that the design of multimedia instructional materials requires the designer to consider the range of learning styles of the intended user. They suggest that such consideration, coupled with meaningful instructor and peer feedback during the design and development stages facilitate the designer's skill in selecting appropriate instructional multimedia materials to meet the specific needs of learners. The basic premise of this paper is that the design of multimedia materials is a critical educational technology experience for undergraduate and graduate teacher education

Assessment

Two papers offers methods for assessing multimedia and hypermedia projects. Dickens presents a preliminary rationale and describes a critical method for assessing student multimedia and hypermedia projects. The method is adapted from an existential-phenomenological model for aesthetic criticism developed by Eugene Kaelin and is suggested for its ability to take into account the content and structure of complex objects. In his paper this framework is presented and parallels drawn between the critical role in aesthetics and the facilitators role in assessing complex objects to communicate understanding of substantive content in teaching and learning

Lennex describes the development of a digital portfolio on CD-ROM in which students represent their student teaching experience with digital media. Preservice teachers are required to produce an interview portfolio by the end of student teaching, and the digital portfolio serves a dual purpose: it demonstrates the New Teacher Standards developed as part of the Kentucky Education Reform Act (KERA), and also the technological proficiency desired by administrators and school systems. The objectives of this study include determining the present perception and current technologies regarding digital media, especially among MSU preservice secondary teachers; developing a model for a digital portfolio; and producting digital portfolios among MSU preservice teachers as an alternative to traditional portfolios. This article describes the various processes used to create and complete a digital portfolio during a twelve week student teaching experience.

Special Areas Of Multimedia Development

In the area of medical education, Weidner and Gifford describe a study which examines a multimedia program used in different contexts.This paper presents data from a preliminary study that addresses several important issues such as rote memorization of facts and vocabulary in traditional science education classes such as anatomy. The study compared the way pairs of students used the representationally rich multimedia program *BrainStorm: An Interactive Neuroanatomy* under two conditions. In the first problem-based condition, pairs were given a patient case featuring symptoms resulting from injury to neurological structures, and were asked to solve the case by identifying the structures involved. This type of problem-based learning offers alternative learning strategies to counter the acquisition of inert knowledge, knowledge that is not easily applied to new situations. In the second question-response (QR) condition, student pairs were given more traditional questions to answer about these neuroanatomy structures. The results of this study offer interesting insights into the usefulness of different learning strategies.

In the area of special education, DeMartino and Prinz examine several important issues that apply to the use of technology in special education. Their paper describes the learning needs of special education students and includes an overview of technological needs and instructional modifications as well. The authors note that the main obstacle for using technology in special education is the apprehension of teachers to learn the technology.

Video Technology

Four papers describe the use of video technology in a variety of educational settings. Abate describes the preliminary development of a technology in the classroom video project. The product is targeted for use with an audience of pre-service and in-service teachers and includes examples of teachers using a variety of technologies with their students in a manner that reflects how comparable technologies are currently implemented in the workplace. The video examples include elementary, middle and secondary classrooms from urban and suburban schools across the nation. The goals of the video project include showing what occurs when teachers place students in realistic situations that require themto collect, analyze, apply and communicate information. The second goal is to encourage teachers to examine how classroom experiences may relate to employment and career opportunities.

Kurth and Thompson describe the process of creating, developing, and evaluating a video which uses an "anchored instruction" approach to modeling the integration of technology and teaching. The results described include descriptions of the processes in which video model examples were created and edited, and the intended use of the videos in staff development training for higher education faculty. The authors cite the need of teacher educators to see specific, concrete examples demonstrating effective technology integration.

Banks describes the development of an interactive training tool, Virtual Classroom Visits, that captures the expertise of third through seventh grade teachers who taught units in science, social studies, and language arts using multimedia composition software with their students. The program on CD-ROM contains detailed information and behind the scenes work these teachers performed in order to facilitate successful student projects. The program includes video footage of classrooms in action, and the types of information that teachers would gather on their own if they had the luxury to participate in a week-long site visit to a school where accomplished teachers were using multimedia in the classroom. Preliminary results of this study show that the teachers did learn a great deal from the interactive application.

Stephens and Byrum describe the properties and uses of Digital Versatile Disks (DVD) as a new medium for more powerful applications of video in the preparation of teachers. This paper discusses the structure of DVD, variations, cost, and the process for mastering. The potential value of this new tool in video-case methodology is addressed.

Collaborative Development Teams

Finally, McNeil shares some preliminary insights in the development of educational multimedia software by collaborative development teams. Critical factors in team communication, collaboration and cooperation are examined and explored in a case study format of two graduate classes.

These thirteen articles address the various aspects in which new media, in the forms of multimedia and hypermedia, have influenced teacher education. Current technological and training issues are identified as well as various educational benefits of this new media. These articles

provide excellent examples and a firm foundation for improving teacher education programs.

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Multimedia and Cognition: Training Teachers About Using Technology

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Multimedia has changed the way that information is being transmitted and received in our society. Examples of this range from CD-ROM's that use larger-than-life graphics, realistic video and compelling music, to the Internet where one can play an interactive game, listen to a favorite band from Denver, or watch a NASA video clip of Mars. Multimedia is part of a new way that information is being repackaged and delivered and thereby processed by the end-user. Multimedia is usually defined as a program that uses a combination of media to present information for entertainment or education; however, this definition does not really go far enough. It overlooks the assumption that interactivity is a significant component of multimedia and that the user must interact in accessing the information. The term "multimedia" connotes a user who is actively engaged accessing, interacting and processing information.

Multimedia and Interactivity

This definition of multimedia has significant implications for current perceptions of learning. Learning at home has become a more active, self-guided process especially as more problem-based explorations of the Internet or interactive gaming across phone-lines occurs. Learning has become a constructive process (Salomon, 1997), whereby students are independently constructing networks of interconnected meanings on their own without the formal guidance of a teacher. Our students are starting to access information in a highly interactive, multimedia format. Their perceptions of the world are being shaped by not only what type of information they can quickly access but also by the way the information is accessed. Oftentimes, the information itself is not the important message but how it is accessed and through what delivery system.

This paper explores these issues as they relate to teacher education. Multimedia Production is a required course in the 18-credit Instructional Technology Certificate Program at Fairleigh Dickinson University (FDU), the largest private university in New Jersey. Most students who take this course are enrolled in the School of Education's Master of Arts in Teaching (MAT) program and are studying to be a teacher or are currently teaching. This course becomes a significant experience for those who take it because it offers an in-depth examination of how multimedia can be used in the classroom. Not only do students explore how to produce a multimedia program, but they explore current issues and research about using multimedia in the classroom, as well. As technology becomes such a pervasive aspect in our lives, all teachers must understand the implications of technology and how it is affecting the learning process, regardless of whether they use technology in their own classroom or not. The question becomes whether this course should become a required course for all students who will become certified as teachers.

Multimedia as a Symbolic Form of Representation

Multimedia is a new symbolic form of representation, much as language or mathematics is a form of representation. As a representational form, multimedia influences the meanings one arrives at, the cognitive skills that are called for, and the perceptions one derives of the world (Salomon, 1997). Students using multimedia as a presentation device represent their thoughts in different ways than those who use paper and pencil. Similarly, those who access information via multimedia formats, must call upon different mental processes than those who use a book or video. Researchers have shown that different symbolic forms of representation are processed by different sets of mental skills and capacities (Eisner, 1997; Greeno & Hall, 1997; Salomon, 1997). This has powerful implications for teachers who must understand the positive and negative implications of this phenomenon that is currently occurring. If different mental capacities are being called upon, teachers must be aware of how to positively develop them so that they are "mindful" and purposeful. Students need to become technologically literate, not in the sense of learning new software programs, but in the sense of knowing how to use these new tools to promote higher order thinking skills and how these tools can help in the process of creative problem solving. Teachers

must learn how to use these new multimedia tools for disciplined, structured learning that is goal directed.

This type of approach is being used in the Multimedia Production course taught at FDU. At the beginning of the course, the teachers read research related to different symbolic forms of representation and discuss what this means in terms of broad, general applications in the classroom. They must first apply this to the areas that they teach, whether it be science, mathematics, or literacy. When students read charts, interpret data and apply formulas, they are working in a symbolic form of representation that is different from written language. Teachers also become aware that language is a symbolic representation of what we are thinking and that each representational form is shaped and constrained by the cultural aspects that surround it. Thus, in our culture there is only one word for "snow" while Eskimos have many words to describe this phenomenon, as do skiers. The teachers are then asked to relate this research to multimedia production. They discuss how multimedia is a new and different type of symbolic representation and therefore is processed differently. They discuss how our culture is becoming inundated with multimedia products and how students are learning to process it haphazardly. The teachers also become aware that like other forms of representation, multimedia need not be taught as an end in itself, but must be considered a useful tool for constructing meaning and for communicating information and understanding (Greeno & Hall, 1997).

Another area that the Multimedia Production course addresses is the potential negative attributes of the new technological media. Current technological media, particularly the Internet and the interactive multimedia packages, may affect their users' minds by mirroring the same kind of erratic, disassociated, "unmindful" wandering among the various connections, yielding a very unstructured, nondisciplined approach to learning and comprehension. This nonreflective approach may influence how students learn in the classroom when this is what they are practicing and being exposed to at home. Is the new MTV generation spawning a generation of impulsive, random thinkers, incapable of processing a long, reflective literary work? Teachers must start thinking about these issues in teacher training classes.

Healy (1990) has been exploring the effect of electronic media on how the brain processes information. She posits that higher-level language skills such as the ability to use language can occur only with stimulation and growth in the left hemisphere of the brain at specific periods of time during child development. She claims that children's experiences with electronic forms of communication may be predisposing them to deficits in higher-level linguistic and organizational skills of the left hemisphere and in the effective coordination between the hemispheres. Like a muscle responding to exercise, the brain becomes stronger in the areas that are being used and weaker in those areas that are not. Children may lack practice in the use of left-hemisphere systems of auditory analysis and the skills of logical, sequential reasoning. As the language of our culture increasingly promotes electronic communication, our students and their schools are increasingly becoming mismatched and our students are becoming less linguistically sophisticated over time.

Postman (1986, 1992) claims that the habits of the mind and styles of discourse it fosters influences the way the one perceives the world and interprets its truths. To Postman, print is a better epistemology than any electronic medium because print inherently promotes rationality through its sequential, propositional nature of the written word. Following the written word means following a logical line of thought which requires considerable higher-order linguistic ability such as classifying, inference-making and reasoning. Postman feels that today's new electronic media do not promote coherence but instead promote habits of the mind that harm public discourse. Our culture is starting to regard everything as entertainment and all information must be presented through a bombardment of images. Such warnings from researchers must be carefully examined by teachers because although electronic media may not pervade every classroom today, children are increasingly and unrelentlessly being exposed to this in the outside culture.

Attributes of Multimedia

The Multimedia Production course also examines attributes of multimedia that affect cognition and that teachers should be aware of as part of their training. One such attribute is visual literacy. Multimedia inherently promotes a visual orientation toward learning. It allows information to be presented and processed visually and therefore in a nonlinear, more holistic fashion. For many learners, visual representation of information enhances and expands their capabilities to learn and remember. Visual images provide the connections between the abstract theory and the practical, graphical representation of that theory. Currently, we are moving toward an integrated and interdisciplinary approach in education that encourages students to seek thematic interrelationships. Visual tools help to facilitate this connection between linear thinking and holistic, non-linear thinking, and these tools help students see patterns and relationships between concepts and interdependent systems (Hyerle, 1996). Visual tools are a strong link between teaching content and developing thinking processes by encouraging students to graphically represent thoughts and ideas in a holistic fashion before converting them into a more linear, written format. Graphically representing one's thoughts allows students to attend to alternatives and new perspectives.

Multimedia promotes this type of learning in two ways: by having teachers and students develop mulitmedia

products, such as HyperStudio or HyperCard stacks, to use in the classroom, and by having teachers and students access information which is presented in a multimedia format. Visual literacy is promoted in both cases because it becomes the symbolic means of representation that is being used. When multimedia is used extensively in a classroom, the way a teacher presents the content changes from didactic presentation of facts and concepts to a more process-oriented approach which emphasizes how content can be effectively presented and graphically represented (Cohen, 1997). Cohen (1997) studied a technology-rich social studies class that was using HyperCard stacks to present projects. She found that classroom discourse changed dramatically in this classroom. Conversation often addressed visual representation of concepts: how should pictures be placed on a screen to enhance learning, how should a template for a project be formatted to expedite learning, how and where can images be scanned in effectively. These issues all contributed to students becoming more visually attuned and literate so that when they accessed information they were aware of high quality images that promoted learning, and they were aware of low quality images that confused and confounded them. These are important issues for teachers to be aware of.

Another attribute of multimedia that affects cognition is its ability to promote multi-sensory learning. Multimedia integrates all different types of media into one program. Because of this, multimedia allows a student to use a multitude of senses in accessing and interpreting information; it allows students to use their unique combinations of intelligences to study a topic. Students usually prefer one style of learning and feel highly motivated when using that style in pursuing their studies. Some learners prefer information to be written; others prefer it to be spoken; some need concrete examples; others need visual representation. Multimedia programs allow a student to utilize their preferred style of learning while also developing those areas they are not as strong in. Thus, if a student is a visual learner, he or she will be motivated to visually access information from a multimedia program while also having the capability of reading the information, or even hearing the information read to him or her. Thus, a multi-sensory approach is inherently taken with multimedia learning.

Furthermore, cognitive science and research on the brain tells us that students learn best when information is taken off the page and brought to life in the minds of students. The objective is to immerse students in compelling experiences which are evocative, challenging, meaningful and coherent environments for the brain to effectively process information (Caine & Caine, 1991). Students must have opportunities to make connections, and extract meaningful patterns and global relationships in what Caine and Caine (1991) have called "dynamic gestalts." Caine and Caine claim that multi-sensory representations such as multimedia programs is one such gestalt which facilitates learning.

Non-linear learning is another attribute of multimedia that affects cognition. Multimedia is unique in that there is not one linear path through the program but a multitude of branches in which a learner can explore each topic as interest dictates. Although some researchers criticize the non-linear format as being detrimental to the development of logical reasoning, the ability to explore a subject matter based on personal interest and choice can be highly motivating for students and offers them a "dynamic gestalt." It allows them to see the big picture when desired and to narrow in on details at other times. As Reinking (1997) says of hypertext, multiple digressions might be considered a defining attribute of hypermedia programs. On the way to looking up one topic, a student digresses to other related or oftentimes marginally related topics. As he points out, digression can be positive and enjoyable because there is no compulsion to follow the one main idea. Reinking (1997) also points out how elementary students reading science texts, explored the meanings of more difficult words, and recalled more of their content when they read passages displayed by a computer that provided immediate context-specific assistance through branching and non-linear format. Although students can get "lost" in digressions or teachers might not be sure all material is "covered", non-linear format can be highly motivational, effective, and facilitate learning in a highly engaging environment.

The last two attributes of multimedia, self-paced and individualized instruction, are significant factors that affect cognition. Students learn best when they can go at their own pace, they can explore the subject matter in their own style, and they can make their way through the material in their own path. Individualized instruction allows a student to repeat the content or the process when desired or needed, gives immediate feedback, and branches to material that help support the student's process of learning. Individualized and self-paced instruction also allow a student to go back and reread, if necessary, supporting the metacognitive skill of rehearsal. It can provide the necessary scaffolding to support a student or remove it quickly as the student progresses to the next level. The ability of a student to receive individualized instruction comfortably at his or her own desk is a strong and compelling attribute of multimedia instruction.

In summary, when we examine many of the features and attributes of multimedia instruction, they are many of the same features that researchers and educators are promoting as part of the reform movement toward more meaningful, relevant classrooms. The important point is that many of the attributes of multimedia discussed here do affect cognition and teachers should be aware of what this effect is as part of their training. Attributes such as visual literacy, multi-sensory learning, non-linear learning, self-paced instruction

and individualized instruction all affect the way a student learns and processes information.

Conclusion

As our society shifts from using print as a primary symbol of representation to using electronic media to present information, there are major implications for the classroom. Whether this shift provides impetus for those who wish to further stress the importance of print and language as a symbol of representation in our culture, or it provides a rationale for those who wish to include visual literacy as part of the curriculum, we as educators cannot choose to ignore either the positive or negative implications of this change. Multimedia has become very much a part of our life and will continue to exert a large influence over the way information is presented and processed. Those who train teachers must start examining many of the "hidden" attributes of technology that affect the process of learning. Technology has become such a pervasive force in our society, teacher trainers must start addressing these key issues in their classes.

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On the Effects of the Expansion of Multimedia on Teaching

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We can claim that computers are the most important invention of twentieth century. They have dramatically and irreversibly changed the ways we live and work. One of the implications of this is that all educated people should be computer literate. Developments in the area of multimedia technology and the introduction of it into education process have changed the character and methods of education. Computer associations are united in their wish to help the field by providing guidelines for school curricula, courses and knowledge. This paper discusses issues about the relationship of education and multimedia technology.

Multimedia systems handle different media types - text, graphics, animation, images, video and audio. They depend critically on available hardware technologies - high performance CPU and I/O bus architectures, high quality audio-visual input/output devices, large capacity data-storage devices and high-speed networks. In addition, these systems require a much higher level of system software support in comparison to past computational and communicational environments.

Depending on type of education in which multimedia systems are employed, emphasis is put on different elements of multimedia. Scientific and engineering applications usually serve as a tool for simulation, understanding and visualisation of scientific and physical phenomena. Applications used in arts and lower level education categories include multimedia authoring and presentation, hypermedia browsers and digital libraries (Putnik, 1994).

Introductory computer education courses have several characteristics. Traditional "computer literacy" courses were developed years ago at universities and colleges and emphasised learning the "alphabet" of computing, gaining experience with basic kinds of software packages such as word-processors, spreadsheets, and database systems and studying some historical and social aspects of computing. These courses familiarized thousands of students with computers and enabled many of them to actually start using them.

Recently a new philosophy has emerged. With computers beginning to play a more important role in people's lives, a deeper understanding of them has become a necessity. A new concept has emerged for teaching scientific principles and requiring problem solving, rather them memorization (Biermann, 1994).

Educational Aspects of Multimedia

Multimedia technology employs methods and techniques for organising, retrieving and presenting information in a wide variety of formats. This can improve the effectiveness of the educational process. It is important that educational software use active learning techniques and the learner be expected to "do things". This also leads to implementation of techniques in artificial intelligence in the design and implementation of educational multimedia systems.

If we want to use multimedia in education, we must take into consideration characteristics of human learning process:

- It is goal-directed. People are willing to learn if they have an interesting goal.
- It is failure driven. Mistakes are the causes for learning.
- It is case-based. Facing a problem, people think of a similar situations they encountered, helping them to solve the problem.
- It occurs naturally by doing.

Using this approach, we want to build a multimedia educational system that will:

- create engaging environments for learning,
- create situations which allow student to make mistakes,
- give student the access to expert opinions relevant to the problem,
- use the advantages of the multimedia environment making education more realistic.

What kind of lecturing should be used in a specific school depends on materials available and the teachers' education. Still, when using multimedia technology in education, some characteristics of learning process can be given:

- Pure theoretical lectures are not suitable and should always be combined with some kind of practical training;

- A system for CAL (Computer Assisted Learning) should enable professors to present topics, explain difficulties, emphasise details and illustrate contents of a lesson.
- Intelligent tutoring systems (ITSs) integrate course material, student models and diagnostic capabilities within a unified framework. Such s system incorporates two stages: an authoring system that enables an instructor to develop/tailor the course contents and a course presentation system that communicates this information to the user. An example of this kind of system was developed at the Institute of Mathematics in Novi Sad (Budimac, Putnik, Ivanovic, Paunic, & Jerinic, 1990) and used at the school for talented pupil in Loznica. Later, a programming language LESS (Ivanovic, 1992) for creation of lessons in ITS has been defined, and its creation is in process.

Apart from negative aspects of such a system, the need to learn a manipulation interface, the positive achievements gained by such systems are much greater and knowledge is more easily accessible than through the use of the traditional methods of learning.

To date, education multimedia systems such as multimedia encyclopedias, are useful in the presentation of information , and usually employ "page-turning" architecture. These pleasurable and luxuriously designed systems may divert attention from the more fundamental issue in everyday education - reforming the outdated and ineffective methods of teaching. This brings us to the same place we were before computers entered the field. Pure information representation technique in education fails for the same reason as the table-lecture system failed at some level to bring more advancement in education. It brings to a pupil inert knowledge, not connected to the real-life situations, too often not useful and applicable and usually forgotten. Improving this paradigm by the introduction of multimedia technology will not change the basic problems of this teaching method. Asking the pupil to turn the next page of information is a bad idea, regardless of whether the "page" is text, graphics, or video (Schank 1996).

Conclusion

The availability of sound and moving video on desktop computers started a revolution in the way information is viewed. Students are more willing to learn since they perceive multimedia information as data that can be stored and manipulated, rather than as material delivered from cinema or television over which they have no control. Each media display, graphic, text, simulation, or animation, is connected to and identified by the system as a different representation of the same information (Woolf, 1995). Evaluation of such systems shows that students progress to the same mastery level in one-third of the time required by conventional education. Furthermore, students using these systems show a 40% improvement over their performance from classroom instruction (Lajoie & Lesgold, 1992).

We must make clear distinction, however, that lectures are not fancy slide-shows, musicals or animated experiences but learning experiences. Audio-visual material can provide valuable aids for teaching systems, however the system is only useful if the learner remains active and motivated and if he wants to learn and is involved. The learner needs to be challenged to reason about the material presented. Flashy graphics and simulations are not enough; the experience has to be authentic and relevant to the learner's life.

Multimedia learning environments must be educationally effective and provide students better quality of experience than traditional teaching methods. When they work well, they can let teachers spend less time lecturing and more time working with individual students. Such systems with a motivated and well educated teacher can make computer education as effective as one-on-one tutoring and still as affordable and widespread as television.

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Analyzing Influencing Factors in Hypermedia Learning: A Case Study

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Hypermedia is software technology. The basic elements of hypermedia include nodes, links, buttons, browsers, trails, navigational tools, and programming language. It can contain discrete information nodes to present texts, graphics, audio, video, animation, film clips, or other types of information. These nodes can be further linked, associated, or networked with other sets of information, nodes, technologies, or media. By using hypermedia, learners can view from node to node, jump around nodes, or further determine the interrelationships among all of the connected nodes. Some of the often-used commercial hypermedia packages are HyperCard and HyperStudio for Macintosh computers, ToolBook and LinkWay for Windows, and Authorware for both Macintosh and Windows.

Regarding hypermedia learning, most of the research effort was on revealing the effects of using hypermedia to enhance learning, rather than on the factors that enhance the process of hypermedia learning. Past research on the acquisition of basic computer skills including computer operating, word processing and data managing, suggests the use of increasingly challenging exercises to enhance computer skills learning (Compeau & Higgins, 1995). Research also suggests that learners should be given time to learn, and they should be allowed to learn from basic to more advanced computer skills (Lee, 1997). Learners should be allowed to experience repeated success throughout the whole learning process (Compeau & Higgins, 1995).

The purpose of this study is two-fold. First, it covers how a hypermedia course offered to part-time graduate students was designed by incorporating the above suggestions as important learning factors. Second, it presents the student responses to a questionnaire that inquired students' reactions toward those factors.

The Hypermedia Course and the Incorporated Factors

This graduate level hypermedia course was designed to train students to produce a hypermedia program by using the selected hypermedia software, ToolBook, from procedures of planning, storyboarding and authoring.

There were seven class sessions in this course. During each class session, the instructor included lectures, discussions and group activities on the theoretical perspectives of computer-based instruction (CBI) or computer-based training (CBT). The instructor also included hands-on demonstrations of functions, tools and usage of ToolBook. A final project was required for the course.

The major factors incorporated were: first, the hands-on exercises followed a hierarchical sequence of presenting new or advanced phases of learning which built upon the progress achieved from earlier exercises. The idea was that students would encounter continuous success and achieve a higher level of comfort and performance. Secondly, although all students learned ToolBook, under request, they were provided with flexibility of using ToolBook or the program of their choice to complete the final project. Such flexibility allowed the students to have more control over their learning. Finally, during the seven-week course students were given three classes to work on their final projects to ensure that they had enough final project development time.

The Students

Each student during the first class completed a pre-assessment questionnaire. Information was gathered on age, educational and occupational background, years of teaching and/or training, and computer knowledge and experience. The 11 adult, part-time students consisted of four males and seven females. Education and corporate training were the two dominant occupational backgrounds.

All of the students had access to computers. Word processing and basic data management procedures were the primary uses. Only two students had experience in the areas of computer and hypermedia programming. These two students were the students who chose to use web-based authoring hypertext to develop their final projects. The remaining nine students used ToolBook to develop their final projects.

Student Responses to the Questionnaire

Four major questions were included in the questionnaire to reveal the student responses toward incorporated factors in the course. The following presents each question and the student responses.

Question 1:

The hands-on exercises followed a hierarchical sequence of presenting new or advanced phases of learning which built upon the progress achieved from earlier exercises. The idea was that students would encounter continuous success and achieve a higher level of comfort and performance. Please describe the ways in which these exercises impacted your learning.

The student responses included:

"I believe that worked as you planned. Exercises did build on each other and they were well paced."

"It allowed me to test a topic before moving on. I was able to relate each piece to prior knowledge, understand its fit, then move on to the next topic with a much stronger base - which this allowed me to see/ learn that topic."

"The exercises enforced the principles of Toolbox that we needed in order to successfully complete our final project."

"The structure of these exercises facilitated my learning. We were able to work at our own pace with guidance, then build on our previous accomplishments. My confidence increased as I moved through the exercises."

"I liked having a demo first, just to watch and learn. Then follow the hand-out, step-by-step instructions to try it ourselves. Then we were free to try new things based on what we learned, and combining knowledge gained from previous lessons. Very effective!"

"I liked how you broke down the class periods so that we would learn one concept (graphics) and try to apply and practice it right away."

"They were broken down into digestible chunks. It made learning the tool simple and allowed me to focus more on content development."

"Doing ToolBook tutorial helped introduce the product, and allowed me to see what it 'looked' like. However, I was a little overwhelmed with all the info presented. The exercises were sufficient, I would have liked a little more practice to truly get comfortable. But once I started developing my project, I realized I had enough exercise and knowledge to get through the basics."

"I felt that it was an excellent way to teach a program. It eliminated the confusion normally experienced when an entire program is taught at one time, with little time for practice."

"It is a good introduction to the tools."

"I felt more confident with the completion of each exercise. The exercises made me more comfortable with ToolBook; the more relaxed/confident I felt; the easier it was to pick up a new concept or task."

Question 2-1:

Although all students learned ToolBook, under request, you were provided with the flexibility of using ToolBook or the program of your choice to complete your final project. For students that used ToolBook for your final project: Do you feel that you learned as much as those that did not use ToolBook for their final project? For students that selected another type of hypermedia for their final project: Do you feel that you learned more, because you were given the flexibility to use a different program?

Student who selected ToolBook responded to the question by indicating:

"This is very difficult. I can't compare because I donít know what they learned. I feel I learned a good deal. Starting from zero and being able to craft a program that demonstrates knowledge, of learning theory in seven weeks to me is great!"

"Yes, however, I strongly suggest a course on HTML as one of the CBT criteria options. Perhaps a brief overview of other authorware tools would benefit us as well."

"Donít know what those who didnít use ToolBook learned. There were very few things I was not able to figure out how to do, that I wanted to do, with ToolBook."

"I feel that I learned more because ToolBook provided me with more "bells & whistles" than any other application I would have chosen."

"Yes! Only because I was not at all familiar with ToolBook - so I learned a great deal.

I have nothing to compare it to. My own experience is I learned what I wanted to learn. The tool did not interfere with my learning. This is contrary to what some Authorware users have said. Regardless of what tool is used, the focus needs to be on design. You can learn a tool later."

"Yes, I am happy with the amount of learning I got using ToolBook."

"By using ToolBook it forced me to learn another program and platform. Although it would have been easier for me to do it on HyperStudio (Macintosh) I would have missed a valuable opportunity. Especially since the world is going to PC."

"That depends; considering I had no previous multimedia experience I may have learned more in the terms of new concepts and material."

Question 2-2-1:

For students that selected another type of hypermedia for their final project: Do you feel that you learned more, because you were given the flexibility to use a different program?

Students responded to the question by indicating:

"Absolutely. The intent of the program should be to develop an understanding of the underlying principles of CBT development, not limited to a single authoring program.

More? I felt a greater responsibility to achieve, to learn. I felt as if I had a say in my own learning, ownership."

Question 2-2-2:

For students that selected another type of hypermedia for their final project: Did the lack of instructor guidance for using the program of your choice hampered your learning experience?

Students responded to the question by indicating:

"Not at all. Part of using any program involves figuring out how to do it. The instructor was good at pushing the theoretical more than the technical."

"No, It enhanced it. I find Authorware too cumbersome and was allowed the flexibility to make my own decision."

"No, I found guidance from trial and error. Finally, the instructor can provide evaluative guidance once project is complete."

Question 3:

For all students, how did the flexibility of choosing ToolBook or another hypermedia program, for the final project effect your learning experience?

Student responses were:

"It enhanced it. My program was much better and more functional as a result

ToolBook is somewhat inflexible. Having to use tool gave me sensitivity for what would make a better tool."

"It served as a positive aspect of the course. It gave all students the opportunity to learn CBI through a means that was most applicable to them."

"The experience became more relevant to our actual experiences. We were able to select a hypermedia program that already be available to us. Allowing us to use a tool that would benefit us more outside of this classroom."

"I learned far more by using an application new to me."

"I thought that it was neat that students were allowed to choose a program. However, the students who chose something besides ToolBook may have chosen a program he/she was already familiar with, therefore he/she may have missed out on learning ToolBook to itís capacity."

"It was good for me to use a different tool because I had to look for the similarities in the tools."

"I was only interested in learning ToolBook and apply my skills in the final project. To be honest I didn't realize until last week that we had the option. If the goal was to show our knowledge of instructional design, than any authoring program could accomplish the task. It would have been easier for me to incorporate more graphics and multimedia if I used a program I was more familiar with."

"It gave me the opportunity (structured) to develop with a tool that has "personal" meaning to me and my future career endeavors."

"For me not at all; intended to use ToolBook from the start."

Question 4:

During the seven-week course students were given three classes to work on their final projects. Do you feel that the class time provided was helpful or excessive? Please explain.

Student responses included:

"I think that the pace and amount of time was just right. If I suggest any change at all, it is to shift the focus from ToolBook to a web-authoring program so that it is closer to what people will be using."

"I required much more time. The class time was great, but for me it was not excessive. I liked having class time because of access to instructor input."

"Very helpful designing and producing a quality CBI takes time and thorough review. Since we are full-time workers and the project was complex, it gave us

the necessary time to do our final project. Three classes is an efficient amount of time."

"Class time was helpful. We were given the opportunity for individual guidance which would be difficult during a structure class time. The class time allocated to our projects allowed for a better balance between school and other responsibilities."

"I was fortunately able to use ToolBook at home; at work, but considering the amount of time I spent on my project, I believe one more class time would have been sufficient along with some week-end time put in. I feel that I needed the three class periods for project time. I also spent an extra eight hours beyond that time working to complete this project. However, I donit feel that you should increase project time, because that would take away the actual instruction time of ToolBook."

"Very helpful. Without time to practice the theory we learned, it would have been less inpactful."

"I was very grateful for the three classes. I was very anxious in the beginning weeks to get started on the project and by the time the three work classes arrived, I had enough info and skill to begin. I was also glad that Doris was available during these classes. I would have liked to started storyboarding sooner or flow-charting. Because I would have felt more organized sooner. But all in all I felt content, time and instruction all met and/or exceeding my expectations!"

"I feel this was essential as I only has access to ToolBook at this campus. As you know most of us put in quite a bit of additional time, besides the three classes, to complete our programs."

"Very helpful."

"Class time was very helpful. In fact, I wish we had another half class period."

Discussion and Conclusion

From the student responses, it is clear that the hierarchical design of the course structure and hands-on exercises allowed the students to work at their own pace with guidance, then build on previous accomplishments. Students' learning confidence increased as they moved through the exercises. The hierarchical design made learning the selected hypermedia simple and allowed them to focus more on content development. Students felt more confidant with the completion of each exercise, and the more confident they felt, the easier it was to pick up a new concept or task.

As for the provision about the flexibility of using ToolBook or another authoring program of their choice, students responded positively. The majority of the students felt that the flexibility of choosing ToolBook or another hypermedia software served as a positive aspect of the course.

Students who used ToolBook for their final project were satisfied with the amount of learning they received using ToolBook. Students who used other types of hypermedia felt they learned as much as other students did. These students believed the intent of the course should be to develop a thorough understanding of CBT development, and should not limited to a single hypermedia or authoring program. They did not feel the lack of instructor guidance for using the program of their choice hampered their learning experience. They suggested the coverage of the web-based hypertext development software should be included in the course content.

Most of the students responded that the project development time allotted was helpful and appropriate. They revealed that designing and producing quality CBT takes time and thorough review. Since most are full-time working professionals, and based on the complexity of the project, there was necessary time to develop their final project.

To conclude, the students in this case study felt very positive about all the factors incorporated in the course. For future research, it may be necessary to examine the necessity and appropriateness of covering both hypermedia and web-based authoring software for computer-based instruction or training.

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Developing Multimedia Instructional Materials with Teacher Education Students

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Traditionally, teacher education programs have focused on introducing undergraduate and graduate teacher education students to a wide range of instructional materials, teaching methodologies and instructional strategies for effectively classroom use. Inadequate attention has been given by teacher education programs to the development of meaningful instructional materials. In the development of instructional materials, teacher education students must think carefully about the specific instructional purpose, use and possible adaptations of the material. In addition, in designing effective instructional materials, designers must consider matching the material with a range of learning styles.

The authors suggest that undergraduate and graduate teacher education students who have engaged in the process of designing and developing instructional materials are better equipped to evaluate commercially prepared instructional materials and match these materials with individual learning styles and needs. The development of multimedia instructional materials, therefore, is an essential precursor to the effective and meaningful evaluation of the wide range of multimedia software available to teachers. Furthermore, the design of multimedia instructional materials requires the designer to consider the range of learning styles of the intended user(s). Such consideration, coupled with meaningful instructor and peer feedback during the design and development stages facilitate the designer's skill in selecting appropriate instructional multimedia materials to meet the specific needs of learners. In essence, the design of multimedia materials is a critical educational technology experience for undergraduate and graduate teacher education students.

Multimedia Tool Software

The use of multimedia tool software provides teacher education students with multifaceted integrated learning experience. The authors' use of multimedia tool software in undergraduate and graduate educational technology courses indicate that these experiences engage students cognitively, creatively, affectively and socially. During the design stage, students using multimedia tool software engage the higher order cognitive skills, as they create concept maps, storyboards reflecting concept branches, design text, select meaningful images, create or select appropriate sound and music, "draw" and "paint" appropriate graphics, plan animation sequences, and develop related learner activities. Throughout the design process students are constantly engaging their cognitive skills of analysis, evaluation, and synthesis.

In the development stage students have access to multimedia design tools which produce and/or "capture" and present graphics, sound, video, and text. Students use predesigned graphics and sound libraries, or they use the drawing and sound tools in each program to create original designs and record real time sound and voice. Library video clips may be used, or students may use Quick Cam video cameras or video cam cameras to capture video clips. In addition, non-copyright protected graphics may be imported from other software programs and/or from Internet sites by utilizing the "snap-shot" and copy commands. In this multifaceted design process, students are also expressing their multiple intelligences (Gardner, 1990) and their work evidences specific visual, auditory, conceptual, and interactive emphases.

The authors have worked with undergraduate and graduate students in the design and development of multimedia instructional materials over a period of four semesters and have observed this learning experience to be a powerful, creative, affective and social experience for students. They have also observed that students are willing to invest 20 - 30 hours into the preparation of multimedia instructional materials and are enthusiastic about the opportunity to share their "products" with other students. Students have reported the experience to be a powerful integrating cognitive and affective experience for them. Furthermore, students have reported self-perceptions of being more analytical in regard

to the elements of "good" instructional software as a result of their multimedia design and development experiences.

The authors have used two multimedia tool programs, "Hyperstudio" and "MicroWorlds," with teacher education students. These programs share a few common features such as drawing and word processing tools.

Hyperstudio: Software for a Mediacentric World!

Hyperstudio is an excellent multimedia tool program for teacher education students. Program tools enable the user to design an electronic "stack" which may include video clips, graphics, text and sound. The stack may serve as a presentation or interactive engagement with a concept, idea, mood, setting, etc. Graphics libraries contain over 200 MB of clip-art and clip-sounds. However, users may also import into their stacks non-copyright protected graphics from other programs, CDs or the Internet. Users may also record voice, music and other sounds into their stack. A wide range of drawing tools and word processing tools are provided in the program. The storyboard feature enables students to resequence individual "cards" within each stack.

Microworlds: A Logo-based Hypermedia Environment

Microworlds is also an excellent multimedia tool program for use with teacher education students. Sophisticated multimedia projects may be developed using only menus. Microworlds also contains a strong Logo component which enables students to animate graphics. While it is possible to use Microworlds without a knowledge of Logo, the authors have observed that teacher education students with prior knowledge of Logo use the program more effectively than students with no prior knowledge.

Guidelines for Using Multimedia Tool Software with Teacher Education

The following guidelines for using multimedia tool software have emerged from the authors work with undergraduate and graduate teacher education students:

- basic computer skills are prerequisite to working with multimedia tool programs,
- use systems with a minimum of 16 MB RAM and Zip drives,
- instructor should demonstration procedures specific to software,
- student may develop individual or cooperative multimedia projects, and
- all students present their multimedia projects in-class.

Multimedia tool programs require large amounts of RAM (minimum 16 MB), and student projects often require more disk space than a floppy disk provides necessitating the use of storage media such as a zip cartridge.

In classes where the instructors demonstrated specific program procedures using a computer projector, prior to student use of the procedure, students were more satisfied with their multimedia instructional design experiences. Whole-class demonstration provided an opportunity for specific questions and discussion related to procedures. Most students prefered to observe a demonstration of specific procedures before they tried the procedure on an individual basis.

Students have reported that the opportunity to work cooperatively on the design and development of multimedia instructional materials has been a positive and meaningful professional experience for them. Students share ideas and "intelligences" and experience a team sense of accomplishment with the completion of the project.

Most often, however, students have chosen to work individually on their multimedia projects.

All students should have an opportunity to share their multimedia projects with the whole class. This experience enables all students to share design and development problems and discoveries. Without exception, the process has been a positive affirming one for each student.

Concluding Remarks

Successful student experiences with the design and development of multimedia instructional materials depends on the instructor's ability to ensure that students develop the necessary prerequisite skills, and have access to adequate hardware. Without both, the student's multimedia design experiences can be a source of significant frustration and stress. When instructors are able to implement the guidelines suggested by the authors, the design of multimedia instructional materials provides teacher education students with a rich repertoire of technical computer design skills. At the same time, students experience their multimedia design and development experiences as salient integrating professional experiences.

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Toward a Critical Methodology for Assessing Multimedia/Hypermedia Creations

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One of the most interesting and innovative approaches to integrate information technology into classroom practice is the use of student created multimedia and hypermedia projects. In this paper, hypermedia is distinguished from multimedia by the use of dynamic "links" which permit items of information to be connected by their relations or associations rather than in a linear page to page manner. The critical method should work equally well for both, but only the hypermedia project will be used in the discussion that follows.

Complex Objects and the Need for a Critical Methodology

The capacity to represent knowledge in a variety of media and to connect items of information dynamically characterizes the hypermedia format. We designate this type of creation a complex object. The way that the complex object represents knowledge and communicates its ideas is distinctive and requires a method for adequately assessing its meaning that is appropriate to its form. In an effort to develop such a critical methodology we have turned to an already established method for critical evaluation from the arts. The model of communication and the framework for the method are based on work initiated by Eugene Kaelin (1962, 1968) for aesthetic criticism grounded in phenomenology and existential philosophy. In this paper, we will present this framework and draw the parallels between the critical role in aesthetics and the facilitators role in assessing complex objects to communicate understanding of substantive content in the teaching and learning context.

Kaelin develops a model of aesthetic communication that we believe to be appropriate for the manner in which other complex objects, i.e., student multimedia and hypermedia creations, embody meaning. Kaelin (1962) deals with two fallacies that represent extremes in the way that a work of art is understood. The first is the "affective fallacy" in which consideration is given only to the psychological effect on the audience. This attitude is evident in expressions like, "I don't know much about art, but I know what I like." At the other end of the spectrum is the "intentional fallacy." In this view, only the creator's experience is considered, i.e., what was meant or intended whether realized I the work or not. Kaelin proposes a principle of relevance that brings the creator and the appreciator together on the same side of the object.

> Only that intention of the artist is relevant which is actually expressed in the work before the artist and appreciator alike, and if this is the case the intention and the work are the same; only those feelings are relevant to the work which are controlled by the phenomenally objective structures of the work itself, entering into an intersubjective experience of both artistic communicants... In aesthetic experience the work serves to mediate the experience of creator and appreciator. (p. 333)

The implication for the case of student creations is not that they are exclusively expressive objects in the same sense that a painting, poem, or sculpture may be said to be, but that their total significance is embodied in what they present and the modes of representation chosen. We suggest that the critical assessment of student creations by both the creator(s) and the critic requires a similar methodology to be adequate. We further submit that few teachers or students are prepared to conduct such assessments without training in an appropriate methodology.

Role of the Critic and Role of the Facilitator

In the aesthetic context the artist/creator by the manipulation of the materials brings into being an expressive object. The audience/appreciator then engages in an analogous dialogue by opening themselves to the work itself which mediates the experience of it. Not all potential appreciators however bring to the engagement the necessary experience and understanding to participate in the artistic communication. The critic's role, according to Kaelin, is to "lead an audience to the fulfillment of the artistic communication." (1962, p. 352) What the critic does is "not to state what the work of art means; but rather to show how it is constructed, and of what it is constructed, so that a third person may grasp its significance in an act of integral perception." (p. 353)

The teacher in the facilitator's role is also attempting to assist the creator and appreciator alike to better understand the significance of the communication embodied in complex objects. We can liken the significance to the expressive understanding embodied in the student work. The facilitator most often is not stating the meaning, but assisting the creators in clarifying their own created knowledge as presented in what they actually do in the creation of the complex object. While there are also matters of the simpler and more direct communication of discursive items within the context of the complex object, the very nature of multimedia and hypermedia objects seems to call for consideration to be given to the manipulations of the various media and the relations established within the complex object in a similar fashion to that of the aesthetic object.

Postulates for the Interpretation of Significance

Kaelin develops four postulates for interpreting aesthetic significance based on his existential aesthetic theory (1968).

Postulate 1. All aesthetic significance is context bound.

Postulate 2. An aesthetic context is composed of counters and their relations.

Postulate 3. No aesthetic counter has absolute significance, i.e., each has only that significance which is made apparent by a relationship to some other counter within the context.

Postulate 4. The significance of the context is the felt expressiveness of all the counters as they fund or come to closure in a single experience.

With minor modification, these same four postulates may be applied to the interpretation of significance in the context of complex objects. First, we understand the significance to be context bound. This is a direct extension of the communication model in that only what is actually done in the work itself can be said to have significance. Next, the context is composed of counters and their relations. Counters are the parts that make up the whole. Counters in the aesthetic sense may be further classified into surface counters, non-representational forms, and depth counters when the arrangements (relations) among surface counters further represent objects, ideas, and images.

The third postulate essentially states that the significance will be found not in individual counters, but rather in the way that these individual components relate to other components. This is especially important when considering the context of a hypermedia creation where the links between items of information implicitly or explicitly establish relations between parts.

Postulate Four serves as the basis for our judgment of the significance of the complex object. In the assessment of the student project, all counters and their relations are to be considered and a standard of closure applied. By closure we mean the way in which each and every counter and their relations contributes to or distracts from the clarity and completeness of the complex object's significance.

The Methodological Framework

The method for critiquing complex objects based on the four postulates is divided into two main sections, the description and the judgment. While it is possible to intersperse description and judgment in a critique, we have found it most useful in the instructional setting to treat these as separate but related parts. In order to describe the counters and relations that comprise the complex object, we first perform the phenomenological reduction or *epoché*. Based on Husserl's phenomenology, the epoché requires that we "inhibit or suspend (put out of action, 'turn off') all belief in existence that accompanies our everyday life and even our scientific thinking." (Spiegelberg, 1976) In our context, we are simply asked to hold in abeyance the value of our own beliefs and understandings in order to be open to the experience of what the students have actually done. This essential step is intended to adequately describe the counters and their relations and make our judgments as to their significance based only on what is actually done.

By "bracketing" our experience of the object itself, holding off preconceptions, personal knowledge and beliefs in the adequacy of that knowledge we are setting the stage for the phenomenological description of the various counters and relations that make up the complex object in its totality. The importance of the reduction to the process of criticism is that we want our judgments to be about the significance of the object itself, not how it may compare to our own understanding of the content under consideration. The goal of the critical method is to assess the students' understanding as embodied in the context. In other words, we are trying to infer how the students' understanding is communicated by the work itself.

It is for this reason that the method begins with the description of surface and depth counters and their relations as they are presented. Accepting that the complex object is the only context in which significance will be found, it is only what was actually done that can have weight in our judgment.

The distinction between surface and depth counters in our descriptions and the relative importance of each may not be as clear as are the distinctions that Kaelin makes when considering their role in the way that a work of art expresses itself. The sensuous surface of a painting, for example, has surface counters that are readily distinguishable from experiential depth. The direct manipulation of the media by the artist produces such surface counters as line, shape, color, size and position. If and only if these manipulations also represent objects are there depth counters to be considered. Such distinctions may be important in critiquing a work of art that may or may not be, in any sense, representational. Surface counters and their relations may represent

objects, objects and their relations can suggest ideas, and ideas can have iconograpic significance as images. For example, the arrangements of the artists material (paint on canvas) may be used to represent the figure of a woman and an infant. This relationship can be interpreted to also signify the idea of mother and child. The image of mother and child might signify the image of Madonna, nurture, etc.

At this point we have not attempted to create a comprehensive list of possible surface counters for the criticism of complex objects. Color, shape, position on the screen, size of individual components, etc. can be described and may have significance. Generally speaking, however, the type of object that makes up our context is assumed to be a purposeful representation of depth counters by their very nature. What is of greater concern for our purposes is that we describe what was actually done by the creator(s) in constructing the object, interpreting its significance based on what is described, and finally rendering a judgment of the adequacy of the total context in expressing a clear and relatively complete expression of understanding.

By rendering in language what we perceive in the students' creations, we can use the descriptive component of the critique to initiate dialogue with the creators and assist them in clarifying and constructing representations of their own understanding of the knowledge being considered. By basing judgments only on what we have described we are able to provide valuable feedback to the students regarding the adequacy of their output and help them better understand how the complex object communicates.

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Digital Portfolios in Secondary Grades Preservice Teacher Education

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Portfolios are a common factor of life for preservice teachers in Kentucky. In this case, they are representations of success in the New Teacher Standards developed as part of the Kentucky Education Reform Act (KERA). These standards represent various aspects of the profession such as content knowledge, classroom instruction, professional development, collaboration, and evaluation of students. Preservice teachers compile evidence throughout their student teaching experience to demonstrate these goals. Appropriate use, instruction of, and the application by students in technology is present in all eight New Teacher Standard areas.

The "notebook" medium of portfolios is changing in many ways. For the last two years, some public schools in Kentucky have been exploring the use of digital media for creating middle and high school student portfolios. As a result, multimedia products such as ClarisWorks, HyperStudio, and PowerPoint have become staples in these classrooms. The argument among these groups, as with others across the country, has been that digital media facilitates the collection, archiving, and transition of portfolios through twelfth grade (Milone, 1995; Lynch, 1996).

At Morehead State University (MSU), I decided to do something "different" with my student teachers. The idea was to create a digital portfolio on CD-ROM in which students would dynamically represent their student teaching experience. Since preservice teachers are required to produce an interview portfolio by the end of student teaching, this would serve a dual purpose: a digital portfolio would demonstrate not only the New Teacher Standards, but also the technological proficiency desired by administrators and school systems. The objectives of this study were to (1) determine the present perception and current technologies regarding digital media, especially among MSU preservice secondary teachers; (2) given these perceptions and technology, develop a model of the successful digital portfolio; and (3) implement the production of digital portfolios among MSU preservice teachers as an alternative to traditional portfolios. This article describes the various processes used to create and complete a digital portfolio during a twelve week student teaching experience.

Background

As a teacher educator with access to preservice secondary students, the next logical steps were to determine my pilot group's parameters. I began the pilot study of digital portfolios in the 1996-1997 school year. Student teaching consisted of one 15-week semester split between a campus methodology course, EDSE 415 and field experience, EDSE 416. Students would be on campus for four weeks prior to school placement and several follow-up classes throughout the semester for EDSE 415. As a prerequisite to student teaching, MSU students are required to pass two of the following computer skills courses in the Teacher Education Program: "Teaching Skills and Media," "An Introduction to Computers," a computer workshop, or a CLEP exam.

Because rudimentary computer skills had been successfully covered in the prerequisite courses, I decided to proceed during the four weeks of campus training with basics in electronic mail, PowerPoint 95, video and audio capture, and scanning of photographs. The time spent on these applications was limited since the nature of the course was focused on instructional methodology in student teaching. Students from Fall semester were required in this course to demonstrate competency in technology basics by completing the following:

1. Locate ERIC documents through an Internet connection and e-mail the results to me.
2. Locate Listservs and Bulletin Boards of interest and e-mail me the purpose of the groups and the procedures to join.
3. Scan one graphic and one text piece, write a summary of procedure, and submit a disk containing the scans to me.
4. Develop a five-slide presentation on PowerPoint and demonstrate the results to the class.
5. Attend a video and audio capture workshop.
6. Send electronic journals each week during the student teaching.

Also, the student teaching semester allowed up to two personal days for absences. I distributed a letter to all cooperating teachers asking that they allow at least two more days for students to work on their portfolios on campus if necessary. A multimedia facility was available for students to schedule.

I changed the assignments in second semester to reflect needs demonstrated in Fall semester. I added the following:

1. HyperStudio instruction and development of a five-slide demonstration.
2. ClarisWorks, Toolbook, and Macromedia demonstrations
3. Specified weekend training sessions throughout the student teaching semester for audio and video capture, PowerPoint application, HyperStudio application, and specific multimedia work.
4. Development of a World Wide Web page to address student teaching needs on a regular basis.

Conditions at the student teaching sites varied tremendously throughout this pilot. Six students were placed in large, metropolitan/urban school systems, six in large, suburban schools within fifteen miles of a metropolitan center, three in a suburban/rural system within thirty miles of a metropolitan center, and one in a rural school system about forty miles from a metropolitan center. Most of the school systems have internet access for teachers, but at least eight of the students did not have e-mail at their schools. I requested from the school technology coordinator an electronic mail account for each student teacher. This had to be cleared with the Kentucky Department of Education as it was adding an individual to their electronic mail system. The process took up to ten weeks to complete in some cases. Of these, seven students used dial-up accounts at their homes for e-mail and one simply mailed journals to me. The last case eventually did receive e-mail, but could not send it to me successfully without forwarding it through an intermediary at another school. At least two of the schools were very advanced and possessed scanners, audio and video equipment, as well as highly trained personnel capable of facilitating technology knowledge.

Results

On the first day of each semester, students in my section of EDSE 415 were asked to respond to several questions regarding technology. There were eleven student teachers in the fall semester and five in the spring for a total of sixteen in the pilot study. Their attitudes and practices with technology were questioned heavily. All but one of the respondents believed that they were competent in word processing and using a computer. The students had used PC's most often, but had some experience with a Macintosh. The groups were initially split over the issue of using technology in the classroom. Many believed that technology meant "computers" and stated that they should not replace a living teacher. Others simply stated that technology should be increased so that skills were taught in public schools. The attitudes toward technology were expressed far too vaguely to be described accurately from Fall semester. Spring semester students noted some enthusiasm, but little actual experience with technology.

On the last class meeting of each semester, a similar survey was given to the preservice teachers. At this point, fifteen of the sixteen preservice students had successfully completed student teaching. None had yet completed their portfolio when the survey was given. Students were again asked their attitudes and practices with technology. Of those responding, all claimed to have competency in word processing, PowerPoint, and scanning photographs and text. However, several others noted proficiency in using ClarisWorks, video and audio capture, HyperStudio, and electronic mail.

The attitudes toward technology had clarified somewhat during the semester. Fall semester students were quite vocal about their attitudes after having completed student teaching and the portfolio requirements. All students were heartily in favor in technology incorporation in the classroom. Many stated that they felt this project would increase their worth in the job market as well as provide more creativity to their teaching. Two respondents added that the stress and pressure of student teaching were compounded by trying to complete a digital portfolio during the semester. All but two of the students used the Internet for up to twenty hours of classroom related instruction and job searches. All noted that group instruction on specific workshop dates throughout the semester would have been beneficial.

Spring semester students were given group instruction during Saturday workshops on campus in the multimedia labs. Initially, they were somewhat enthusiastic, but hesitant, because of their admitted lack of technological skill. Their attitudes toward technology became ambiguous as the semester continued. As the workshops progressed, students completed all of the assignments required, but did not go beyond this point. At least two of the students were able to complete all requirements on their own and did not attend the workshop sessions. The remaining students were eager to learn, but did not exceed expectations.

Of the sixteen students involved during 1996-1997, nine successfully completed a digital portfolio. Successful portfolios contained a resume, educational philosophy, lesson plans, student work, and letters of reference and/or transcripts. Another five completed portions of the portfolio which would come to represent their contributions to the project. Two did not complete any work on the digital portfolio.

Conclusions

This pilot project has yielded a good amount of knowledge regarding the attitudes and practices of technology among a small group of preservice teachers. They are generally enthusiastic about using technology, however some think this means computers only. These teachers have used the Internet somewhat and are willing to use it more frequently for classroom applications given the knowledge to do so. Many will use this knowledge to create future classroom activities which will encourage student learning and advancement in specific fields of study.

It would seem, though, that MSU's preservice teacher education program is not adequately preparing teachers for continued use of educational technology. Basics in word processing simply will not be sufficient for teaching the students in today's schools. Before having this pilot project, students were comfortable only in word processing. After the project, many admitted that they see a need for revision in the program to reflect current technology. Instruction and application into critical thinking with technology is clearly indicated. Otherwise, we may be facing a future of automaton teachers who do not know how to go beyond the textbook.

I believe that the production of digital portfolios is viable, however some variables must be considered before undertaking such a project. The state of Kentucky had promised to upgrade all its schools to Internet capability and classroom readiness before the end of school year 1997. As of this writing, the date has been pushed back to school year 1998. Having seen many of these schools, I suspect that the date will be pushed even further. Also, as with many school systems, monies are not available for professional development and training with technology. These funds must go toward state test score improvement and building maintenance. The technology may be in the schools, but few teachers are actually using it at this point. This, together with college coursework and personal biases unrelated to education, will affect the attitudes of preservice teachers. Anecdotally, those schools with access to technology and the trained personnel to assist teachers, tended to be dens of inquiry and creativity. Six of the nine successful portfolios were produced by preservice students in the highly technologically advanced schools. This semester I have begun a new pilot analyzing the attitudes and practices of preservice personnel and their cooperating teachers.

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Teacher Support of Multimedia Use in Problem-Solving vs Question-Response Contexts

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Traditional science education, including that in anatomy, has been criticized for promoting a static and disassociated approach to the domain, exemplified by the memorization of specialized vocabulary. This approach to learning may result in knowledge that is not easily applied to new situations, what Bransford and Vye (1989) refer to as inert knowledge.

Problem-Based Learning

One instructional strategy offered as an alternative to counter the acquisition of inert knowledge is Problem-Based Learning (PBL). This method is typically instantiated as a group learning technique involving 5-6 students with a faculty tutor. The role of the tutor is not to provide domain expertise, but to evaluate both group and individual progress in acquiring conceptual understanding and problem solving skills. The domain content is embedded in a series of cases, presented as problems for the group to discuss.

Advantages of Problem-Based Teaching and Learning

The instructional advantages of problem-based teaching and learning (PBTL) over conventional whole-class synchronous instruction have been documented by a number of researchers, representing a broad range of theoretical perspectives in cognition and learning (Barrows, 1983; Albanese & Mitchell, 1993; Nii & Chin, 1996). The learners in these studies have ranged from first-year college students, enrolled in basic science courses, to first-year medical residents, making their first independent hospital rounds. The success of PBTL has been attributed to a number of factors. Norman and Schmidt (1992) argue that PBTL is more effective because it encourages learners to take greater control over their own learning, a stance closely linked to improved metacognitive and self-regulatory skills. Newble and Clarke (1986) contend that PBTL is more effective because it appears to foster a deeper approach to learning; that is, students are more likely to employ elaboration techniques to incorporate new knowledge into existing cognitive structures. Other authors also have claimed that the method appears to result in better retention of material than when presented by traditional means (Norman & Schmidt, 1992; Eisenstaedt, Barry, & Glanz, 1990). Finally, in most of these studies, it is generally preferred by students, who view it as superior to traditional teaching methods because it fosters a more nurturing and enjoyable learning experience (Albanese & Mitchell, 1993; Sobral, 1995).

Disadvantages of Problem-Based Teaching and Learning

However, PBTL is not without its disadvantages as well. For one, the cost of PBTL over the lecture method appears to be greater. Albanese and Mitchell (1993) cite the findings of Donner and Bickley who estimate that PBL requires an average of 17.4 faculty hours/year vs. 4.8 faculty hours for lecture instruction. Some students also have encountered difficulty in building an effective knowledge base. This finding has been evident in the generally lower scores of PBL students on the National Board of Medical Examiners - Part I, which tests for basic biomedical science knowledge (Albanese & Mitchell, 1993). Additionally, some students are simply uncomfortable with the method and prefer more traditional techniques. These students may simply need more direct instruction and guidance, especially early in their medical school careers.

Related to this speculation is the discussion by Norman and Schmidt (1992) on the relationship of structured feedback to successful problem-solving and transfer:

> The study of concepts while attempting to solve a problem appears to be an optimal strategy for spontaneous transfer of the concept to new problems... However, it is not sufficient to engage in the act of solving the problem; students must receive corrective feedback during the course of attempting to solve the problem. (p.561)

Norman and Schmidt cite conflicting studies of performance in solving clinical problems by PBL students from two universities: one study found PBL students to perform less well than conventionally trained students, and the other

study had the opposite results. Norman and Schmidt conjecture that the difference may be due to the former curriculum being "less structured, which may result in less corrective feedback and the persistence of conceptual errors" (p. 562).

Role of Technology

Computer technology may prove to be an important component in the support of PBTL, and may help to alleviate some of the shortcomings associated with it, including its cost and potential lack of structured feedback. However, the ultimate impact of this instructional tool, as with all tools, will be directly linked to how it is used in the classroom. Although multimedia programs may provide well-developed and immense information resources just a mouse-click away, the user may become lost in this maze of information, and become frustrated or confused. This possibility may become especially significant when using multimedia to support PBTL, since the lack of direct feedback is frustrating to some students.

Much work is ongoing to investigate how computer technology can provide the feedback necessary to promote effective learning. Merrill, Reiser, Ranney, and Trafton, (1992) compared the guidance offered by human tutors with that offered by intelligent tutoring systems. They found that computer tutors share many of the same characteristics as human tutors, and have been shown to provide comparable instruction, both of which are superior to students learning on their own. However, much of the difference between the two approaches pertains to the increased flexibility and subtlety evidenced by human tutors, which may result in allowing students greater freedom to discover knowledge and control their learning. This difference may change in the future. Computer technology appears to have the long-term potential to provide immediate and personally customized feedback to a student as s/he progresses through an instructional program. Vahey and Gifford (1995) cite examples where feedback can not only be customized for the learner, but can also be optimized for the particular situation. However, at present, the idea of technology personalizing feedback is much easier to appreciate as a concept than to implement in practice. Ross and Morrison (1993) point out that truly personalized feedback will not become possible until computers can analyze a student's free and spontaneous answer to a question and respond accordingly. This inability to analyze free text remains a major limitation of computer technology, and underscores the importance of the instructor's role in providing useful feedback to the learner in a timely manner.

Computer Support of Problem-Based Learning

To date, relatively few studies have been published with regard to how multimedia can support problem-based teaching and learning. Hooper, O'Connnor, Cheesmar, and Price (1995) report on their use of multimedia-based clinical cases to aid in the learning of medicine in a problem-based manner. Advantages which they found included self-paced learning, feedback, and a deeper understanding of the basic physiological processes underlying the problems. Lee, Rutecki, Whittier, Clarett, and Jarjoura (1997) compared the efficacy of computer assisted instruction (CAI) to a more traditional format in medical students' acquisition of clinical problem solving skills. Although they found it as effective as a teacher-supervised workshop in transmitting conceptual knowledge, CAI appeared not to be as effective in developing problem-solving skills. In addition, students in the workshop ranked their instructional method higher than those in the CAI group. This study further emphasizes the important role of the teacher in effective instructional settings, and continues to feature the computer's role as a supplement to, rather than a replacement for the teacher in the classroom.

The authors were unable to find any studies on how multimedia use in a problem-based format may differ from its use in more traditional school tasks. In addition, to our knowledge there authors found no studies that have been published which compared the type of teacher intervention and assistance appropriate for the most effective use of multimedia under a PBL format.

The Study

Methods

This paper presents data from a preliminary study that addresses some of these issues. The study compared the way pairs of students used the representationally rich multimedia program *BrainStorm: An Interactive Neuroanatomy Atlas* (Coppa & Tancred, 1995) under two conditions. In the first problem-based (PB) condition, subject pairs were given a patient case featuring symptoms resulting from injury to neurological structures, and were asked to solve the case by identifying the structures involved. In the second question-response (QR) condition, student pairs were given more traditional questions to answer about these neuroanatomy structures.

Subjects

The subjects who participated in the project are graduate students enrolled at the University of California at Berkeley. Each group had a comparable educational background including the completion of an introductory neuroanatomy course, and each was previously unfamiliar with the software.

Analysis

We assessed subjects' acquisition of facts and concepts by administering an objective post-test. We also videotaped the subjects while using the program. We paid particular attention to the gestures and references they made to the representations in the program, the discourse they conducted, and the modules they frequented in the software.

Results

The overall average score on the post-test was similar for each condition (PB=66.38%, QR = 68.97%). Both groups performed equally well on items pertaining to terms and similarly on items dealing with symptoms. However, the PB dyad was more likely to answer correctly items relating structure to function (83.3% vs. 58.3%). Conversely, subjects in the QR condition were more likely to answer correctly questions asking for specific details (75% vs. 46.9%). Figure 1 shows these distinctions graphically.

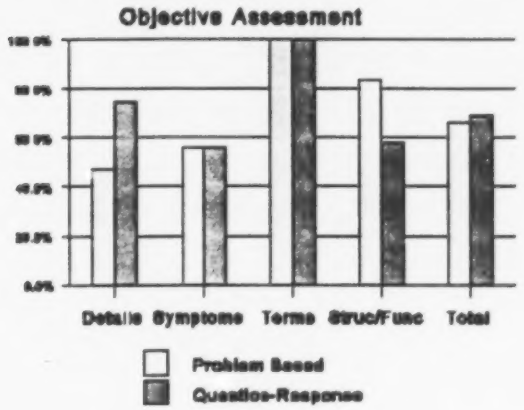

Figure 1. Post-Test Results

Videotape Analysis

Some of the behaviors that emerged in the analysis of the videotape included: structure/function correlation, summarization, observation of details, visual spatial mapping, error checking, floundering, use of orienting gestures, and feeling overwhelmed with the task. The relative occurrence of some of these behaviors suggested interesting distinctions in learning strategies between the two conditions.

Redefining the Task

One finding that occurred with both dyads was the negotiation to simplify the task by addressing the easiest question first. Ultimately, both groups decided to deal with the questions/problems in a different order than the way they were presented. This type of strategy represents a useful metacognitive skill, which should be fostered by instructors.

Use of Gestures

Both pairs utilized gestures to orient themselves with regard to several of the anatomical terms such as coronal, horizontal, and sagittal. By using their heads as referents, and demonstrating with their hands the type of dissection indicated by the terms, they reintorced both their own and their partner's understanding of these concepts. These observations support Crowder's (1996) interpretation of sixth graders using gestures to understand scientific models. Crowder found that when subjects attempted the explanation of a model, they gestured in ways that helped them to coordinate and revise its respective elements. In contrast, when subjects described a previously thought-out model, they were more likely to use gestures that redundantly emphasized speech.

Floundering vs. Frustration

One major difference that emerged from the PB transcript was a long incidence (9 minutes) of what the authors have termed "floundering." This resulted from the subjects misapplying their previous knowledge through an attempt to map symptoms onto an area of the visual cortex rather than onto a part of the visual pathway. As a result, they explored the program in a "non-productive" manner and attempted to elicit evidence that would support their initial hypothesis. One subject eventually discovered the error, and redirected the search effort onto more productive pursuits. This type of unproductive search was absent from the QR transcript, which seemed to illustrate a more purposeful, directed and efficient search strategy throughout. There is some evidence that this difference may be due to the nature of the assignments. Problem-solving in general often leads to unproductive cognitive search strategies (Newell & Simon,1972), whereas locating factual material is a more straightforward process as long as one is familiar with the resources available.

In contrast, although no specific instances of "floundering" were noted in the QR transcripts, nine separate occurrences of what we termed "feeling overwhelmed" were noted. These were exemplified by utterances such as "there's so much to know," "lots of stuff," and "good grief." One way to account for this finding was the way in which the subjects in this condition interpreted their assignment. Although the assignment was intended to uncover a total of 25 concepts/details, the QR dyad actually recorded 38 details on their papers and mentioned several more in their discussion. In contrast, no instances of these types of statements were noted in the PB transcripts and no additional details were reported on their paper. As a result, it is possible to speculate the occurrence of these "frustration" statements may be directly related to the task assigned. By focusing on details, subjects may have the feeling of becoming deluged, especially if these details are viewed as a series of unrelated items. Both of these episodes of floundering and frustration have important implications for teachers.

Attention to Details

The QR pair was more likely to notice details in the program, including the discovery of errors in the diagrams and text. Even though both groups accessed a particular diagram containing errors an equal number of times (3), and spent an equivalent amount of time viewing it (2.5 minutes), only the QR dyad noticed several labeling errors. This was exemplified by the following excerpt in the transcript:

N Yeah 1, 2, 3, 4. This should be 44.
Cursor over Broca's area

	L	44 and 45. There's a little mistake maybe, huh?	
	N	Looks like this is supposed to be a 4 and 5. Well this is wrong though, this should be 17.	Cursor to Broca's and primary visual
3:47	L	Huh, then it's done down here too. See there's 1 and then there's 1 up there. That's strange.	Points to primary visual and post central cortex areas
	N	Yeah., see that should be 17.	To primary visual
	L	They omitted some of the second digits, that must be huh? And what about this one? Primary speech. I mean, primary auditory should be not 4.	Primary auditory area and line with 4
	N	No, it's probably 41, 42. Oh, here's 42, so it must be 41	Secondary speech area
	L	Here's 42, 41. Okay. There's a little, we've uncovered a little glitch	
	N	We found an error. *(Laughter)*	

Figure 2. Excerpt from QR Dyad Transcript

Although it is hazardous to make generalizations about these findings from a single case, one can speculate that they are due directly to the nature of the tasks. Because the question-response pair was directed to answer questions about specific details, the focus which resulted from this assignment may have allowed them to notice more details in the program.

Integration of Concepts

Students in the problem-based condition seemed to exhibit more integration of the concepts embedded in their task. This was demonstrated by the presence of more instances of summarization and review in their transcript. Four specific instances of elaborate summarization were found in the PB transcript compared to only one simple reference to a previous question in the QR transcript. The PB pair also engaged in more visual spatial mapping of their problem onto representations provided by the program. This was not unexpected since these students were given a specific visual image as part of their assignment, but it was also reflected in the way they utilized the program. These students spent 6.5 minutes interacting with the cross-section module compared to less than a minute spent by the QR pair. Conversely, the QR dyad was more likely to access textual information cards than the PB pair (15 instances vs. 7). In addition, the following discourse unit which occurred early in the PB transcript as part of their overall strategy to solve the problem, appears to indicate an integrated approach, in that they expected to accomplish several tasks simultaneously.

Time on Task

Although both pairs spent approximately the same amount of total time in completeing their assignments (45 vs. 47 minutes), and nearly the same amount of time directly interacting with the program (33 vs. 35 minutes), the QR pair engaged in 34% more conversation exchanges (461 vs. 345) and uttered 24% more words and sentences. The greater number of utterances by the QR pair may simply reflect individual differences, i.e., a relatively greater loquaciousness compared to the other dyad. However, it may reflect a more substantial difference in the cognitive processes occurring within the pairs. If the silent pauses represent instances of reflective questioning and thinking, this may have important consequences regarding the relative benefit of these two instructional approaches. One of the most important concepts in recent cognitive theory has been the importance of metacognitive behaviors in effective learning (Brown, 1987). Problem-based learning has been shown to contribute to the development of life-long learning skills (Norman & Schmidt, 1992), so there exists the possibility that PB subjects in this study were exercising metacognitive skills during the pauses in their discourse. Although the interpretation of silence in a transcript is fraught with difficulties, it does suggest an area for further research.

10:54	M	Do you want to do that *[determine the terms]* first or do you want to figure out where it *[the lesion]* is, first?
	T	Umm
	M	Or like, what it is?
	T	That would be more fun, to figure out what it is. I guess we can do that, and we can do this at the same time
	M	Okay, want to do it all at the same time?
	T	We'll keep track of...if we find out what's going on, where it is and what's happening then, the terms will probably come out as we go

Figure 3. Excerpt From PB Dyad Transcript

Discussion

The small sample size makes the task of drawing conclusions from this study tenuous at best and impossible at worst. However, with this caveat in mind, we would like to consider the potential implications these findings may have with regard to the role of the teacher in a classroom utilizing computers for dissimilar instructional tasks.

With regard to both pairs redefining their task in order to simplify it, the question arises as to whether or not the teacher should anticipate this and simplify the task by rearranging the sequence of questions. Some would argue that this would serve to organize the task in a more manageable fashion and reduce the possibility of anxiety on the part of students. Others however, would claim that giving students an opportunity to reorganize the activity for themselves, provides greater engagement in the task, and encourages reflective thinking and planning strategies.

Another related question is whether or not a teacher should intervene when students are "floundering" as they were in the PB condition. What are the dangers in allowing students to pursue non-productive strategies? What are the dangers in not allowing this type of activity? How important is it for students to recognize and correct their own errors compared to the alternative of developing misconceptions? By neglecting to intervene in this situation, one of the students had the time to recognize her error. But is it reasonable to ask teachers not to intervene in similar situations? This may be an area where using a rich source of data, such as multimedia programs, benefits students who are reasoning about a problem. Presumably, by attempting to find evidence to support their hypotheses students will be led to recognize their errors. This appeared to be the case in this study. As a general recommendation, we suggest that teachers use restraint before immediately coming to the rescue of a student searching for answers until it appears that the student is unable to resolve the issue by him/herself.

Similarly, what type of support should be provided when students appear to become overwhelmed by the volume of information as shown by the subjects in the QR condition? In this case, we believe a more immediate form of intervention is appropriate. If a student is misinterpreting an assignment, we believe it is the obligation of the instructor to rectify the situation in order to minimize student anxiety. An even more appropriate remedy would be to pretest written instructions to ensure that they are likely to be interpreted correctly.

Both of these examples raise questions about the support a teacher should provide when students are consulting a computer resource while accomplishing a task. What type of scaffolding should an instructor provide? What form should it take? Should it be available in the software itself or embedded in the task instructions? Should it be offered as direct instruction? Some studies have shown the type of feedback provided within multimedia is not as critical as simply having it available. Generic hints afford opportunities for students to reflect upon and support their thinking, and do not have to be related to the specific topic in the program. By providing this type of support, instructors equip them with a valuable skill that will enable them to continue to be effective life-long learners.

A final issue that emerges as a result of this study is which of the tasks provided for more meaningful learning? It can be argued that if we want students to be able to integrate their knowledge, it tentatively appears that solving a problem fosters this skill more than responding to questions. However, there are instances where it is important to notice

details as well, and the question response condition appears to promote this activity. Perhaps the best course to take is that recommended by Weinert & Helmke (1995) who state "An old piece of educational wisdom is that no single method is the best for all students and for all learning goals." (p. 136)

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A Look at the Role Technology Plays in Special Education

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Hjetland (1995) reports, "Technology can make our lives easier. Everyday tasks are simplified." (p. 2) In reference he identifies examples of where technology has enhanced teachers lives including the use of technology for management tasks, calculating grades, and making lesson plans. However, the use of technology in the classroom for special education teachers has moved beyond simple management functions and is being integrated into a child's education. As technology advances education, it is important that teachers, educators, and special education staff merge technologies' progress into their instruction. A particular focus should be placed on students with learning disabilities.

Background

In 1975, the United States Congress passed Public Law 94-142, which is better known as the Individuals with Disabilities Act (IDEA). This act has changed the way teachers educate children in this country. IDEA mandates that every child between the ages of 3 and 21, regardless of the type or severity of their disability, shall receive a free, appropriate public education (Heward, 1996, p. 25). One of the major tenets of P.L. 94-142 states that students will be educated in the least restrictive environment. This environment is usually in a resource room or special education classroom. However, many state education agencies are pushing school districts to place these special education students into the regular classroom whenever possible. This means regular education teachers have to be prepared to meet the individual needs of students with disabilities. One recent movement has been to use technological advances to meet the needs of these children.

Learning With a Disability

Students with learning disabilities tend not to learn in the traditional ways. In many classrooms, teachers stand at the head of the class and lecture on a given topic. Students are expected to take notes, sustain attention, participate as appropriate, and retain information being presented. However, many special education students are not able to process information presented in this instructional framework. Research has shown that students with learning disabilities need material to be presented in multiple formats and numerous times for them to understand and retain information. As well, reinforcement has been proven to be an essential facet that is often necessary for remembering learned material. With these considerations, instructional modifications can be made which enhance the education of children with learning disabilities. These instructional modifications can be accomplished by using today's technology.

Technological Need for Special Education Students

One major educational focus has been on integrating computers into the classroom. This focus has been heightened by the need for technology in the instruction of special education students. Through computers, teachers can offer any student the opportunity to learn and view pedagogical material in unique ways. However, many of these technological advances are not being appropriately applied to fit the needs of special education students. The utilization of computing technology can create multiple educational opportunities that are particularly useful to special education students and is essential to their education within the regular classroom setting.

Instructional Modifications

Now that many special education students are being reassigned to regular classrooms, special education inclusion is occurring. Currently, many districts and states have moved toward higher levels of inclusion, and it has become important that teachers are able to adapt to these changes. Students however do need certain modifications to be successful in this regular classroom setting and technological advances may be part of the answer. There are simple ways computers can be used to modify a special education students class materials; including worksheet alteration or reduction, creating individualized vocabulary lists, and scanning worksheets for the purpose of modifying text. A teacher can use most word processors' spell check and grammar check functions to create readings that are

appropriate for a special education student's instructional level. These simple technological functions can be combined with other computer uses to enhance the education and instruction of most students with learning disabilities.

Technology is able to assist teachers in providing a framework for teaching and learning, but has to be exercised properly. Individualized education plans (IEP) can include specific instructional modifications where technology can be integrated as an essential characteristic for special education students. As well, teachers can use today's computers for other functions that are beneficial to the education of learning disabled and special education students. A few of the areas where technology can be utilized are:

- Reinforcement
- Providing multiple perspectives, and
- For accessibility options

Reinforcement

Students with disabilities need much reinforcement and computers can be a tool used to attain this goal. One example of reinforcement is through drill-and-practice. Many software programs used in an instructional setting have drill-and-practice activities associated with lessons which act as a reinforcer of learned experiences. The question and answer sessions often compiles a score which can be further used for determining where focused instruction is necessary. Another function of drill-and-practice software is the randomization of questions which reduces the chance of boredom due to repetitiveness. For students who have their own home computer, time can be spent working on enhancing skills they have been practicing at home.

Computers can also be used as a behavior modifier and reinforcer. Many students enjoy using the computer and this enjoyment can be transformed by using the computer as a tool to reinforce good behavior and good performance. As a student accomplishes certain goals s/he may be allocated additional time on the computer. This form of award reinforces good behavior, while options to take away computer time punishes bad behavior. Special education students often respond to this punishment/award system and can be used to a teacher's advantage. For students who have access to computer technology at home, this system of punishment/award is not as effective.

Interactive games can also be used to reinforce concepts previously taught. Through games and simulations students learn. In addition, games have made learning fun and enjoyable, which increases the likelihood of continued learning. This, in turn, reinforces the need for education. However, consideration of a student's skill level must be examined when using this medium. A student who becomes frustrated with the difficulty of a game often responds negatively to this experience.

Multiple Perspectives

Students with learning disabilities respond better to multiple perspectives rather than one perspective regarding instructional methods. With computer technology, teachers can enhance their lessons by providing various perspectives on information. Multiple formats can be integrated to provide students with a variety of modalities for learning and retaining concepts. One way teachers can use this technology is by instructing with multimedia, or making multi-sensory presentations. By using multimedia or hypermedia in a lesson, teachers can represent information visually, audiologically, and textually. Besides the multiple sensory function of multimedia, the Center for Special Education Technology reported "multimedia tools permit the teacher and learner to interact in new ways." (Center for Special Education Technology, 1991, p. 1) They go on to report:

> The teacher's goal of helping the student become an independent thinker and learner can be achieved as the student becomes involved with the content presented through multimedia. No longer is the recall of facts sufficient; the focus is on thinking, applying information to new situations, and solving problems. (Center for Special Education Technology, 1991, p. 1)

By using widely available programs such as PowerPoint, Hyperstudio, or Tool Book, educators can appeal to multiple senses, which enhances learning in special education students. Examples of other available multimedia software that has been used with success in special education are (Center for Special Education Technology, 1991, p. 1-2):

- Jasper series software- uses students' science and math skills as they view Jasper adventures.
- Multimedia Composer- integrated media use to create a composition using texts, video, sounds, and maps.
- GTA, A Geographic Perspective of American History- students create their own show.

These software packages all deal with problem solving and focus on thinking. This new focus is a way of exercising the brain and keep students centered on a learning task without the boredom of straight lecture or question-and-answer periods. As well, the variety offered by these adventures reduce the problem of attention-deficit. These programs also continue to make learning fun.

Accessibility Options

Two major types of modifications are used to accommodate special education students, curriculum modifications and facility/equipment adaptations (Storm, 1993). Curricular and instruction modifications were discussed above, now for some focus on facility/equipment adaptations.

As technology evolves so does the ability to change equipment to suit the needs of any user whether they be a large person, short person, or disabled student. There are two areas where facility/equipment modifications can be studied, one is adaptive technology, and the other is using existing technology and changing the uses to meet the needs of a student. Focus here is on the latter.

One area of concern to many teachers is how to deal with the following problem. The use of computers with special education students is sometimes difficult as their impairment (e.g. hearing, visual) becomes an obstacle. One answer is by using computer operating systems such as Windows 95 and Windows NT. Windows 95 and NT has attempted to solve some of these problems with their built in accessibility options. These options have been designed specifically to facilitate the use of computers by individuals with special needs. These accessibility options can be used to the advantage of classroom teachers in educating their students with special needs. Utilization of these functions can make the difference between success and failure while in front of the computer. A brief review of some functions are in order.

Microsoft in their development of Windows 95 and NT 4.0 was committed to making its products and services easier for everyone to use (Microsoft, 1996). These two operating systems include several accessibility functions that provide users who are movement disabled, hearing disabled, or visually impaired the opportunity to utilize computers with less difficulty. Some of their features enable users to change the display type, mouse, keyboard features, and sound to help users use Windows most effectively (Microsoft, 1996).

A student with visual impairment would be one example of integrating these accessibility options. This student may have trouble seeing the text on the screen, so larger font sizes would be in order. The student could change the display type to enable a higher contrast and/or large default font size. The higher contrast mode makes "objects and texts stand out more visibly." (Parsons & Oja, 1997, p. 134)

Another accessibility options would be using MouseKeys. One can use "MouseKeys to control the pointer with the numeric keypad as well as with the mouse." (Parsons & Oja, 1997, p. 129) A third accessibility function incorporated into NT 4.0 and Windows 95 is StickyKeys. StickyKeys is a feature that makes it "easier for users who have trouble holding down one key while pressing another key" (Parsons & Oja, 1997, p. 132), a common function for many applications. These are just a few of the operating systems functions meant to assist special needs patrons.

Besides Microsoft accessibility options, other systems and software are being designed to assist students in their instruction. A recent technological invention, the Kuzweil 3000 PC-based reading system has just been shown to be successful in Columbia, MD. Two hundred students identified with learning disabilities at Howard Community College used this "easy-to-use system that features text-to-speech software that reads on-screen text in clear synthetic speech and displays text and images just as they appear on a page" (Syllabus, 1998, p. 44) to enhance their education.

Until further advances, including more accessibility options in operating systems and additional software is developed, it is up to teachers to be creative in adapting existing technology to suit special education students. Sharing these ideas and success stories are important to enhancing special education.

Changes Necessary in Teacher Education

The main obstacle of using technology for instructional modifications and as a part of education is the apprehension of teachers to learn the technology. They need to realize that computer-assisted modifications often make the difference between a student being successful in the regular classroom and failing. One way of solving this problem is by providing in-service workshops and training session. These sessions should be implemented by school districts and teacher education programs to instruct teachers in ways to use technology.

In addition, pre-service teachers need to be educated about inclusion and understand the implications for their classrooms. Currently in the state of Texas, there is no requirement for teachers to study special education. One recommendation the authors have is for college/university teacher education programs and education state boards to make observation/special education classroom teaching time mandatory for certification. This would expose future teachers to aspects of special education that they may be dealing with once in the classroom.

Likewise, learning about technology is not enough. Through pre-service and in-service teacher education sessions, educators need to be trained on incorporating technology into their classrooms. They need to know that computers are not just a technological baby-sitter, but can be a powerful adjunct to any students' education.

A fourth issue is dealing with how to put special education and technology training together. As more students are being reassigned to regular classrooms, there will be a greater need for this combined technology/special education instruction. Regular education teachers will need to learn more about and understand the various needs of special education students and technology's impact on these students. Through adequate training, new teachers will be able to integrate technology to all students. The next goal beyond incorporation is motivating these teachers to utilize the computer more often and in unique ways.

Conclusion

Advances in modern technology can give people with disabilities greater control over their lives and increase participation in education. It has been proven that students with special needs can be positively affected by the application of technology. Technology is a valuable tool for persons with special needs by using repetition, motivation, variety of instruction, and small incremental steps toward learning. Computers, accompanying software, and related equipment can help a concrete thinker follow and learn abstract concepts at an individualized rate. They stimulate and immediately reinforce reluctant learners. These goals can be accomplished when trained, dedicated teachers learn and implement the technology necessary for students to become computer literate, and well educated members of society.

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Students as Technology Apprentices - A Video Project

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A technology in the classroom video project targeted for use with an audience of pre-service and in-service teachers is currently under development. The videos in production include examples of teachers using a variety of technologies with their students in a manner that reflects how comparable technologies are currently implemented in the workplace. The video examples include elementary, middle and secondary classrooms from urban and suburban schools across the nation. The goals of the video project are twofold. The first goal is to show what occurs when teachers place students in realistic situations that require students to collect, analyze, apply and communicate information. The second goal is to encourage teachers to examine how classroom experiences may relate to employment and career opportunities.

Technological change is altering how students function at home, at work and in school. The rate of this technological change is frenetic. Common wisdom suggests that by the time a technological innovation is available to most schools it is already obsolete. Attempting to remain current with technological change is a daunting task in any field but it is especially problematic in education where funding levels cannot compete with those available in industry.

There is a fascination with using the latest technology but it is the premise of this paper that a focus on technological innovation in education is misplaced. When considering technology in the classroom the focus should be on relevance. This focus with relevance is based on a basic understanding of teaching. Teaching is fraught with meaning; it is not haphazard or accidental. Consider various teaching strategies, direct instruction, apprenticeship, constructivist approaches, etc.; regardless of the philosophy considered methods employed, or type of assessment used, the act of teaching involves sharing meaning with an audience. Is technology a relevant tool for sharing meaning?

Relevance is a function of the capacity of technology to assist the learner in the acquisition of meaning. As both traditional and new fields of study become dependent on technology so too does preparation for employment in those fields. Examine any occupation and it becomes readily apparent that technology is altering how individuals work. The parcel delivery person downloads data in real time from a hand held device to a computer that uplinks the information to a remote location. The graphic artist uses computer software to produce mock-ups for a magazine layout. A project manager uses spreadsheets to determine the logistics of setting up a construction site. The social worker uses databases connected by telecommunications to verify child support payments.

In each example technology provides the individuals with tools to perform a job more effectively. The goals of production or service industries have not changed but the activities of the workers have. Again, is technology a relevant tool for sharing meaning? It is, when teachers address the issue of technological relevance by engaging students in learning activities that encourage students to use technological tools to solve "real world" problems. The videos under development supply "real world" examples of classroom technology use. Based on experience with other video based teacher education materials, it is hoped that through observation of and reflection on the videos teachers will be guided to consider other forms of relevant technology use in their own teaching (Benghiat & Abate, 1994).

Teacher Involvement

The teachers selected for the School Work videos represent a cross section of grade levels and subject areas. They work in urban schools and suburban schools. To enhance their teaching and their students' learning, some teachers use high technology while others use whatever equipment is available. Often this technology is what many would consider outdated. All provide their students with opportunities to apply the skills and concepts they have learned. In each video, the teachers have identified an activity commonly confronted within a particular occupation, the skills and knowledge required to address the activity and a technological tools commonly used in that occupation. Their lessons require that the students apply what they know to address the issues. The student solutions are shared with a larger audience.

The primary considerations for inclusion in the video project are:

- Do the lessons suggested by the teacher engage students in solving a "real world" type of problem?

- Do the students use technology?
- Do the students share their solutions with a larger audience?

For example, Mike Purnell and Suzanne Malak of Garfield Heights, Ohio presented their eighth grade students with the problem of designing packaging for a fictitious modeling material. In order to protect the integrity of the modeling material, the packaging had to be insulated to withstand temperature fluctuations. The package had to be low cost and easy to assemble, and it had to be attractive in appearance so a consumer would be interested in purchasing it. The students needed to have sufficient knowledge of area, volume, convection, conduction, and radiation as well as basic arithmetic to solve this problem. The students were placed in the roles of engineers and were provided calculators, spreadsheets, and MBL heat probes for conducting insulation tests. Though not as sophisticated, the technology was compatible with the technology real packaging engineers might employ. The students shared the results of their problem solving, the finished packages, with a focus group of fifth graders, the target consumer audience for the modeling product.

Recruitment of teachers was informal. Teachers in the Northeast Ohio area were recruited based on the author's familiarity with their teaching methods. SITE members who were informed about the project recruited teachers in other parts of the country. In addition, some teachers were recruited "word of mouth" via postings with educational organizations on the Internet.

School-to-Work, Seat Work and School Work

The video project uses the name School Work: Technology in the Classroom to describe the underlying goals of the teachers selected for videotaping. The label School Work juxtaposes the common impression of school work as seat work with the current call for career based "learning by doing" within the School-to-Work movement. Seat work typically includes those activities that students complete with either guided or independent practice. The purpose of seat work is to master skills or concepts after the students have received some instruction. School-to-Work combines on the job instruction with school based learning in a structured learning sequence (Churchill, Morales, & O'Flanagan, 1994). The purpose of School-to-Work programs is for students to gain experiences related to specific employment opportunities. The middle ground between these poles is found in what may be referred to as project based school work. The label of School Work emphasizes the relationship between School - the knowledge and skills acquired by students in school and Work - the application of those skills to address real world problems. The Technology in the Classroom label is self-explanatory however several examples included in the videos extend the notion of the classroom beyond the four walls of the average room.

Categories of Technology Use

An important motive of the School Work video project is to provide teachers with general ideas for developing classroom uses of technology. The hope is that the classroom examples recorded on videotape will suggest broader uses of technology across the curriculum. The first consideration to encourage this broader perspective was to establish simple and clear categories of technology use that might be employed to recruit potential teacher candidates. Focus was placed on identifying learning situations that reflect skills typically found in non-academic related occupations. It was assumed that situations would include a technology component but the focus was not on the technology. To simplify the task of narrowing down the candidates for videotaping, it was decided that categories of use be established. The categories needed to be clear and understandable to a teacher regardless of background experiences with technology, and they should not be limited to a particular area of the curriculum or particular technological tool. Finally, the categories must reflect the general skills commonly considered valuable in a wide range of occupations.

It was recognized from the outset that in order to offer a wide range of possibilities the categories would not be mutually exclusive. Three major categories were identified: Communication, Data Collection & Analysis, and Design. Despite vagaries that will inevitably occur when different individuals encounter the categories, they were reasonably clear and understandable when presented to teachers regardless of their experiences with technology. For example, the term communication evokes different skills to every teacher. The language arts teacher concludes written communication, while the music teacher expects audio communication. The learning experiences available that include communication are varied and not limited by content. In addition there are numerous types of technological tools useful in learning how to communicate and the skills needed for successful communication are extensive. The three categories Communication, Data Collection & Analysis, and Design were subdivided further into subcategories in order to assist in the recruitment of teachers.

Communication

Throughout history people have communicated with each other about the world around them. People, events, concepts, feelings, theories - the objects of experiences have been described verbally, in written word and in visual form. The value of the ability to share knowledge through communication cannot be reasonably disputed in or out of the classroom. Communication is a valuable skill in all occupations and there are numerous ways to communicate. In order to assure that a variety of lessons be included in the broad category of communications, seven related sub-

categories of communication were specified. They include: 1) Written Communication, 2) Visual Communication-Single Frame, 3) Presentations or Visual Communication-Multiple Frame, 4) Animation, 5) Video, 6) Visual Communication via Authoring/Programming, and 7) Audio Communication. Table 1 provides examples of the technology tools and sample classroom activities that suggest the creation of a "real world" product associated with the seven communication sub-categories.

Table 1.
Communication

Sub-Category	Tools	Sample Activities
1. Written	Word Processors Desktop Publishing	Books, Newsletters Correspondence
2. Single Frame	Word Processors Draw Programs Paint Programs	Posters Info-graphics Timelines
3. Presentations	Presentation Programs Hypermedia Programs	Transparencies Computer presentations
4. Animation	Draw Programs Paint Programs	Entertainment Describing physical phenomena Animation Programs
5. Video	Camcorders QuickTime Editors	Public Service Announcements School News
6. Authoring/ Programming	Hypermedia HTML Editors	Which Way Books School Web Pages
7. Audio	Tape Recorders Sound Editors	Oral Histories Radio Theater

Data Collection & Analysis

The present era is frequently described as a time period plagued by information overload. It is probably more properly described as a time period of data overload. Information is abstracted from raw data. Information has passed through at least one level of interpretation and someone has analyzed the data to create the transformation. As such, one may argue that students need to develop data collection and analysis skills to deal with the mountains of data that will be generated in their lifetimes.

What are data collection and analysis skills? Many data collection and analysis skills are tied to specific domains. However, the ability to search for, organize, compare, explain, generalize, and make predictions about data are general process skills that surface within a wide range of occupations and problem solving. Three sub-categories were created for the data collection and analysis category. The first, Collection, highlights the skills of search and organization. The second, Collection & Analysis, requires greater interpretation of the data and theoretically can include all of six general skills listed. The third, Simulations, focuses primarily on the skills of generalization and prediction.

Table 2.
Data Collection & Analysis

Sub-Category	Tools	Sample Activities
1.Collection	Telecommunications Databases	Stock Market Reports Weather Data
2. Collection & Analysis	Telecommunications Databases Spreadsheets MBL Probes	Exercise effects Cost of living analysis Demographic statistics Water quality reports
3. Simulations	Spreadsheets Simulation Programs Programming Languages	Yeast production Manufacturing plant simulation

Design

Design means different things to different people. Design is something you do to solve a problem but it is somehow more than problem solving; it is a system for problem solving. Design requires identifying a problem, analyzing the problem, examining how others have addressed the problem, sharing the potential solution, applying various skills to prove the solution correct, selecting the appropriate materials, assembling them into a working solution and evaluation throughout the design process (Shadrin, 1992). Two sub-categories were identified within the Design category: Device Construction and Product Design. Both sub-categories provide opportunities to apply many of the skills identified in Communication and Data Collection & Analysis to solve problems.

Table 3

Design

Sub-Category	Tools	Sample Activities
Device Construction	2D Draw CAD Lego LOGO	CNC Machining Robotics
Product Design	Paint, Draw CAD	Architectural Plans Toy Design

Video Storyboard

Each video consists of three distinct segments. The first segment begins with an individual from one of a variety of occupations describing how technology is changing the way s/he works. One or more technology uses considered in the subsequent lesson are identified during this brief segment. The second segment introduces the viewer to a classroom where a lesson is just beginning. This segment reflects one of the subcategories identified above as well as the criteria of "real world" technology use with a "real" audience. This segment varies in length, as some lessons are quite short whereas others continue over a series of days. However, the edited versions of the second segment are less than twenty minutes regardless of the length of the actual lesson. Each video ends with brief closing comments highlighting what was accomplished by the teacher who taught the lesson.

Conclusions

It is difficult to arrive at any definitive conclusions since the School Work: Technology in the Classroom videos are a work in progress. However, preliminary observations are encouraging. Many hours of teaching have been recorded and prototype videos have been created. The prototype videos were tested with in-service teachers in formal classrooms and informal workshop settings during the past academic year. During the tests, teachers were required to use the technology identified in the video to complete the same or a similar task prior to viewing the prototype tape. This "hands on" experience helped clarify what the students in the video were attempting to accomplish and provided an opportunity for the teachers to consider how these skills might relate to content taught. A common phrase shared with the teachers during this testing was "institutionalize the idea not the activity." The experience of "doing" first and "observing" second helped the teachers move from the literal lesson idea presented to the larger issue of what is learned by participating in this type of activity and it can be replicated with different content. Additional lessons and numerous hours of videotaping are scheduled for the winter and spring of 1998.

The goals of encouraging relevant use of technology, providing students with opportunities to apply their knowledge and skills toward the solution of "real world" problems, and sharing findings with a real audience have been emphasized throughout the initial development of the video project. As a result of attending to the three goals throughout development, the early prototypes have encourage teachers to consider further relevant uses of technology in the classroom. Much work needs to be completed but with the support and involvement of technology using teachers around the country it is anticipated that use of final videos will provide teachers with instructional materials to assist them in integrating relevant technology into their teaching repertoire.

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Case Base Approach to Facilitate Integrating Technology into Teacher Education

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The process of creating, developing, and evaluating an "anchored instruction" approach to modeling the integration of technology and teaching is discussed in this paper. The results described include descriptions of the processes which video model examples were created and edited, and the intended use of the videos in staff development training for higher education faculty. Although many teacher educators would like to utilize available technologies, often they lack the knowledge for implementation. It is at for this reason that teacher educators need specific, concrete examples demonstrating effective technology integration. Our goal in the College of Education at Iowa State University is to provide specific and concrete examples of effective technology integration and to anchor training to the context of a video exemplifying the integration of technology into teaching practices in teacher education.

Background

Although educators and policy makers alike are agreeing that technology needs to be effectively integrated into teacher education, the progress of institutions of teacher education in this area has been disappointing (OTA, 1995). Teacher education institutions are beginning, however, to move toward more integrated and sophisticated uses of technology in preservice teacher education. Though early work in technology in teacher education tended to focus on teaching students how to use the technology or on using technology for completing traditional tasks, teacher education programs are increasingly using technology as a tool to help transform student models of learning and teaching. Teacher education students who have opportunities to work with technology as a tool for their own learning are developing useful strategies for creating their own active learner-centered classrooms.

Proponents of transforming with technology (Bagley & Hunter, 1992; Collins, 1991; David, 1991; Sheingold, 1991) argue that today's technologies have the potential to transform not only the relationships between students and teachers but also how schools now operate. The underlying assumptions of these claims is that computer-related technologies, unlike older media such as TV and film projectors, are also learning devices rather than just teaching devices (Thomas & Boysen, 1984). Thomas and Boysen also suggest that the computer's ability to interact with students and to react to their individual needs has the potential to provide the context for student-centered learning and to assist students in learning to educate themselves. Models of these student-centered environments must be provided for teacher educators.

Although the potential for technology use in teacher education programs is great, there are few models available for teacher educators wanting to create learner-centered technology environments in their own classrooms. Modeling such environments for teacher educators by means of video brings forth a richness in which the participants can observe the uses of technology, the effects it has on students, teachers, and the environment of the classroom.

The common element of "teaching" is present among teacher educators; however, they possess such divergent backgrounds and expertise that traditional staff development does not meet the needs of all involved. The anchored instruction concept, however, provides a situation in which the learners share a common experience (Hasselbring, 1994). Within this shared experience, the learner is able to reflect and develop his/her own meaning contingent on past experiences and present situations and ultimately transfer the learning to new and developing situations in his/her classroom environment.

Using the conceptual anchor in the form of a video can produce a common frame of reference better than any verbal explanation. The verbal interpretation of how to integrate technology will not yield justice to the concept (Blackhurst & Morse, 1996). The video captures a rich and flavorful environment from which the teacher educators can see the emotion, energy, and body language attached to the learner-centered classrooms that integrate technology.

Purpose

The purpose of this study is to design, develop, evaluate, and implement a staff development program that incorporates video cases featuring exemplary technology- using teacher educators.

Procedures

The process of creating, developing, and evaluating this "anchored instruction" approach to modeling the integration of technology and teaching are discussed in this paper. The results described include descriptions of the process in which the model examples were created and edited and the intended use of the videos in staff development training for higher education faculty.

Although many teacher educators would like to utilize the technology that is available, they lack the knowledge for implementation. It is at this point that teacher educators need specific, concrete examples demonstrating technology integration. Our goal at Iowa State University in the College of Education is to provide specific, concrete examples and to anchor the training into the context of a video exemplifying the integration of technology into teaching practices in teacher education.

We have begun videotaping faculty members in the College of Education who exemplify the integration of technology in their teaching methods. Our objective is to create anchored situations in which there is modeling of integration of technology in teacher education. The training process includes teacher educators viewing these anchors together, and, afterwards, an opportunity is provided for reflection and problem solving on how this situation can transfer to individual teaching strategies and classroom environments. Our model is similar to The Cognition and Technology Group at Vanderbilt's "anchored instruction" (The Cognition and Technology Group at Vanderbilt, 1993).

The process in developing this case study involves four basic initial steps:

a) obtaining various video footage demonstrating appropriate integration of technology;
b) editing videos for short clips demonstrating technology integrated into the curriculum;
c) field testing the video by involving ISU College of Education faculty in critiquing and evaluating the effectiveness of the video; and
d) revising of the project contingent upon the results of the field test.

The description that follows explains two of the four processes that have been accomplished to date.

The selection of the faculty members to be video taped was determined by their reputation for technology integration in their teaching. Participants in the study have included faculty members who teach math, reading, social studies, and science methods, and a graduate professor who teaches in Health and Human Performance. Students in these classrooms were also willing to participate and were aware of the nature of the study.

Work in Progress.

To date, video footage has been collected in three different classes taught by two different faculty members. Each video includes teacher demonstrations, student participation, and debriefings following the class by both the teacher and selected students.

The debriefings consist of questions for the teacher and selected students in order to obtain feedback on their perspective. Questions include:

1. In your opinion, what is a learner-centered environment?
2. In what ways did the technology contribute to a learner-centered environment?
3. In what way was a problem-solving environment created by using the technology?
4. What other methods could have been used to teach this content just as effectively?
5. What other pieces of technology could have been used in place of the tool that was used?
6. Do you feel that the technology enhanced or interfered with the lesson being taught?
7. In what way(s) can the application of the technology used transfer to other environments?

We anticipate that in the staff development environment these debriefings will play an integral role by initiating interactive discussions among the participants to collaboratively envision how the modeled example(s) can be modified to best fit and be implemented in their classroom situation.

One faculty member, Dr. A, demonstrated the use of the Jasper series. This class participated in the filming process for two days due to the length of the lesson. Dr. A initially demonstrated the Jasper series to her students to provide them an overview and eventually presented them with the problem that they were to solve. After the introduction, the students divided into groups and proceeded to problem solve the given situation presented in the Jasper series. A few of the groups were positioned at the computers and were revisiting sites on the Jasper videodisc to assist them in solving their problem. The other groups remained at tables discussing and generating questions that needed to be asked in order to solve the problem at hand. During this process, Dr. A's role became one of a facilitator, encouraging students to further their problem solving strategies.

A graduate class in the Health and Human Performance area taught by Dr. B was also filmed for the video case study. Dr. B chose a few students to participate in gathering data through the use of sensors and cameras directly connected to the computer that captured body movements on tape. After data was collected on the body movements of a student participant, the professor demonstrated the ease by which calculations could be made by using the available

technology. Dr. B demonstrated this activity in such a way that the students were generating discussions on how this type of technology could impact their future careers.

After filming was completed, the video editing portion of the project began. This process proved to be a tedious one as the researchers attempted to identify the most meaningful frames of video that would provide the strongest modeling for the targeted audience. Hours were spent examining the videos and marking the clips that were deemed most informative by providing the richest and most meaningful examples. After the clips were marked, they were "captured as a movie" in Adobe Premier. Sequencing the clips and determining the types of transitions and introductions was another time consuming, but imperative, aspect of creating the video.

Plans

The intention of the final product is to provide a context in which real-life examples are provided showing how technology can be integrated into the curriculum to enhance and create a more student-centered environment. The modeling demonstrated through the videos will help teacher educators capture the full flavor of the rich environment in which technology is used to impact learning.

As the videotapes are completed, Iowa State College of Education faculty members will review and evaluate them for effective content and generalizability to teacher educator audiences. The goal is to construct the tapes in such a way that they will influence the whole spectrum of educators in higher education.

This is a project that will continually be augmented as new video footage is added to the existing collection of videotapes. The videotapes will be used in staff development situations for the higher education community with the intention of leading the educators to more of a conceptual approach rather than a procedural one. The videos provide information rich environments in which the educators can draw from the experiences shown, reflect on them, discuss them with others in the training, and determine how the technology use can apply to their situations and what steps will need to occur in order to achieve the type of environment that was demonstrated in the videos.

The evaluation of this project will include various formats. Our goal is to obtain measures of behaviors from our participants by trying to answer the question " Do the participants of the staff development program move on to integrate the technology in their classroom as they saw modeled in the training example?" Questionnaires will be given to the participants to gather information about their feelings using technology within the classroom environment both before and after observing the training video. As well, interviews using open-ended questions will be conducted on a regular basis over an extended period of time. Interview data will be gathered on behaviors and attitudes to see if the participants are actually integrating the technology within their classroom environment. Participants' perceptions of how the use of technology has influenced the learning environment in which they teach is also an integral area from which we will gather data.

Further Development

After we collect over 20 hours of footage in technology rich classrooms, we hope to advance this study by creating a multimedia CD-ROM program to increase the accessibility of this information for participants. There will be a main menu where teacher may choose what information they would like to access. We feel that a greater sense of ownership, freedom, and flexibility in the sense that the participants can pick and choose their destination of information and can revisit any sight of interest at any time. Choices of vignettes will be categorized by content , and options will includeviewing the debriefings of students and teachers, along with reactions of others who have viewed the video series. We envision a multimedia product that will provide an opportunity for the user to see the video cases and reflect upon those cases within a group of teacher educators or individually.

Discussion

The outcome of this project is not intended to be a "quick fix" for staff development programs, but will provide a missing element of the present training situations; i.e. the modeling of appropriate integration of technology to create a learner-centered environment. The educators will require time but, in addition, they need the opportunity to share and reflect on this experience with their colleagues, and an opportunity to practice the modeled activities. Educators will also need support from administrators and trainers, but more importantly, they will need support from each other in this endeavor. Research indicates that the more teachers there are in a location using technology, the better chance that they will continue and grow in the use (Becker, 1994).

Our formal intent is to motivate teacher educators to see a need for change in their classroom, to discuss how this need affects their classroom and teaching methods, and ultimately, to adapt the modeled situation to their specific needs. This collaborative effort of viewing, reflection, problem solving, and construction of meaning will reinforce that the technologies used can improve the learning and transfer of knowledge to the participants classroom environment.

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Virtual Classroom Visits: Teaching Teachers About Hypermedia with Hypermedia

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This research entailed developing an innovative training tool for educators and testing its effectiveness. The tool I have created is an interactive multimedia application on CD-ROM which teaches elementary school teachers how to use multimedia composition with their students by showing them examples of other accomplished teachers doing so in their classrooms. I created this application on my own, which entailed videotaping teachers and students in their classrooms, editing and digitizing the videotapes, designing the software interface, creating the graphics, programming the software, and pressing the CD-ROMs. Ultimately, the goal of my research has been to discover to what extent such a CD-ROM might help teachers learn how to use complex teaching innovations such as multimedia composition with their students.

The "Virtual Classroom Visits" CD-ROM features five accomplished computer-using teachers from the Cupertino Union School District (4 elementary school teachers and one junior high school teacher) who use multimedia composition software with their students for reports in science, social studies and language arts. Often teachers learn about a particular software program but have difficulty actually applying it in the classroom with their students in effective ways. Therefore, the purpose of the CD-ROM is not to teach them how to use the multimedia composition software, but how to integrate it into the curriculum.

The CD-ROM contains detailed information and behind the scenes work these teachers performed in order to orchestrate successful projects with their students, including:

1. Digitized video clips of classrooms in action, showing teachers and students as they used multimedia composition software to complete a group project. This project is shown from beginning to end so that educators can see the entire process – from a teacher's initial instructions to the students' final presentations of their work.
2. Detailed pre-work planning checklists for each teacher, outlining the steps they took to organize, plan and execute their units. These steps included preparing a unit plan, planning their calendar for the unit, reserving computers and other materials, typing handouts, planning assessment, creating student groups, and reviewing floor plans. Detailed information on each of these planning items is included on the CD-ROM.
3. Samples of students' work. This includes the actual hypermedia projects students created for class reports.

The research study for my dissertation involved conducting preliminary interviews with 8 teachers regarding how they would teach a unit using multimedia composition software with their students. I asked questions regarding how they envisioned using the software with their students, what concerns they had for themselves and their students, and then asked them to plan a unit using multimedia composition. I then gave them an opportunity to use the Virtual Classroom Visits CD-ROM. They observed the accomplished teachers on the CD-ROM by reviewing the process each teacher took in completing their units with students. After they used the CD-ROM, I then interviewed them again to determine what they learned from the CD-ROM and how, if at all, it influenced them. During this second interview, I asked them similar questions from the first interview and had them plan their unit again to see if there were any changes from their initial responses.

A preliminary analysis of the results of this study shows that the teachers did learn a great deal from the interactive CD-ROM. In post-interviews which occurred a few days after teachers had used the Virtual Classroom Visits CD-ROM, teachers' were already beginning to incorporate ideas from the accomplished teachers into their own unit plans. Teachers also reported that the information contained in the CD-ROM was very useful for them and that they would refer to the Virtual Classroom Visits CD-ROM when planning other units that involved using multimedia composition with their students.

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What is DVD? What Are Its Possibilities?

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Laserdisks and CD-ROMs containing digitized video have been used in recent years for designing video-case methods of instruction in numerous fields. Cognitive flexibility hypertext (Spiro & Jehng, 1990), for instance, uses video-cases for the preparation of professionals in complex domains such as medicine, engineering, and education. Mini-cases, as described by Spiro and Jehng, are brief, edited "pieces" of the video-case (which can be as short as 45 seconds) that are selected to examine closely and analyze interactions. In cognitive flexibility hypertext, mini-cases are engraved on a laserdisc, accessed through computer programs, and are used for a guided, nonlinear, and multi-dimensional analysis of larger cases. Mini-cases delivered on laserdisc can be accessed readily, randomly and repeatedly.

Video-based instructional programs are limited by the amount of video storage allowed and the quality of video playback. Laserdisks provide high resolution images but can store only one hour of frame-by-frame accessible video. CD-ROMs can hold approximately 20 minutes of Quicktime movies, and these video images often have mediocre or poor quality. The advent of the Digital Versatile Disk, or DVD, presents opportunities for new, more powerful applications of video in the preparation of professionals. It is the newest generation of optical disk storage technology and is basically faster CD with more storage capabilities and which can hold video as well as audio and computer data.

Because DVD provides more space for video and high quality video playback, it promises to become a potentially powerful platform for video-case methodology. This paper will briefly describe video-case methodology in teacher preparation and will present a detailed description of DVD technology.

Video-case Methodology

Video-case methodology captures all the dialogue, actions, emotion, gestures, nuances, body language—the rich flavor of a naturalistic environment. Video-cases on CD-ROM and laserdisk have been used in the preparation of educators, as described by Kinzer, Risko, Carson, Meltzer, & Bigenho (1992) and Risko (1991). Close-up focus of classroom events captured on videotape has allowed program developers to narrow the visual environment and capture an interaction or activity involving a particular person or small group.

Video-case methodology can transcend the current practices used in the preparation of teachers by facilitating the exploration of visual representations of curriculum and pedagogy. In traditional teacher education formats, students conduct individual field observations and then attempt to relate their experiences in writing or orally. The complexity of the context observed is filtered and thus may be diminished in the translation.

In contrast, the video-case format provides a shared observation of experienced teachers in action. This shared experience situates exploration and examination as well as provides a forum for discussion that generates contextualized knowledge about classroom dynamics. Broad theme-based "paths" for exploration such as "teacher role" and "student role" can guide the class, small groups, or individuals as they traverse mini-cases within the video-cases of classroom teachers. Each path presents a view of the mini-cases from different but overlapping perspectives. Professionals-in-training and their instructors can also use their visual explorations as the backdrop for discussion and debate on the diverse perspectives found in professional literature. The benefits of using video-case methodology in teacher preparation have been documented in studies that focus on courses for preservice teachers (Risko, 1991; Stephens, 1995; Fabris, 1996).

Digital Versatile Disk

A DVD looks similar to today's CD: it is a silver platter, 4.75 inches in diameter, with a hole in the center. A digital videodisk is made up of a reflective aluminum foil encased in a clear plastic. Data is stored on the foil as a series of tiny pits formed in a tight spiral on the disk. The pits are formed in the foil by stamping it with a glass master.

It is important that a distinction is made between DVD-Video and DVD-ROM. DVD-Video (often called DVD) contains video programs and is played in a DVD player connected to a TV or installed in a computer. DVD-ROM holds computer data and is read by a DVD-ROM drive in a computer. Many people in the industry expect DVD-ROM to be initially more successful than DVD-Video. Conse-

quently, most new computers will come with DVD-ROM drives and will also be able to play DVD Videos with the proper decoding hardware installed.

Greater storage capacity

There are basic differences in DVD versus CD-ROM which give DVD its enormous storage capacity. The DVD's larger capacity is achieved by making the pits smaller, the spiral tighter, and by recording the data in as many as four layers, two on each side of the disk. To read these tightly packed disks, lasers that produce a shorter wavelength beam of light are required, as well as more accurate aiming and focusing mechanisms. The focusing mechanism allows data to be recorded on two layers. The two layers in a double-layer disk are made of differing materials, a semi-transparent gold layer over a reflective silver layer. To access the first layer a low power beam is used to read the data; to read the second layer, the reader simply increases the power and focuses the laser a little deeper into the disk, where the second layer of data is recorded. Not only are two layer disks possible, but so are double-sided disks by bonding two DVDs back to back. The availability of four layers gives DVD its 17-gigabyte capacity. However, since a 135-minute movie fits on a single DVD layer, single-layer DVDs are more common.

Other factors resulting in the increased capacity of DVD are a slightly larger data area, more efficient error correction, and less sector overhead. Total increase for a single layer is about 7 times a standard CD-ROM. The capacity of a dual-layer disk is slightly less than double that of a single-layer disk. The laser has to read "through" the outer layer to the inner layer and to give more room for error the minimum pit length is increased. The bigger pits spaced farther apart are easier to read and less prone to error, but fewer pits result in less capacity.

Video Compression

Although the DVD storage technology allows for much more storage on a disk, that alone still would not allow for a reasonable amount of video to be stored. For example, for 120 minutes of video (an average movie), 216,000 megabytes of space is needed. That is roughly the equivalent of 360 CDs. Even with the improved storage, it would take approximately 50 DVDs to store a single movie. Thus, video compression or data compression was created in which signals are compressed during the digitizing process and uncompressed for playback.

There are two kinds of compression, lossless and lossy. A lossless compression means that the unsqueezed signal is a reproduction of the original, with no data lost in the translation. For example, each time you use a Zip or Stuffit file, you are using lossless compression. Using a lossy compression is a way of getting even more compressed files than lossless. Lossy compression strips out data that it has been programmed to regard as either unnecessary or redundant. It assumes that human perception will never miss the missing data. Compression works with software called codecs, an abbreviation for "compress/decompress."

MPEG, named after a consortium of industry specialists called the Moving Picture Experts Group, have set the industry standards in compression with MPEG-2. As stated earlier, MPEG is dual-ended process where source material is encoded (or re-recorded) with compression and later decoded (or decompressed) for playback. The amount of compression applied is determined by the people who encode the signal. If too much compression is used, picture quality suffers. Use of too little compression, and not enough space is saved. MPEG compression is very impressive, with typical ratios of 25 or 30:1 before image quality becomes unacceptable. When properly used, MPEG can produce outstanding results with image quality better than videodisk.

DVD Mastering

Once a videotape is edited, it must be specially formatted before it can be encoded and distributed on a DVD. The mastering process consists of several steps, listed below:

- Scanning the videotape to identify scene changes, key frames would be added where there are scene changes or sudden movements
- Compressing the video in MPEG-2 format
- Compressing the audio tracks into Dolby AC3 Surround Sound format
- Combining the compressed video and audio into a single data stream, a process called multiplexing
- Simulating the playback of the disk in the mastering system, a process called emulation
- Writing out a data tape with the "image" of the DVD
- Creation of a glass master, which replicators then use to "press disks"

Videotapes cost about $2.40 each for replication. CDs cost approximately $1,000 to master and $0.50 to replicate. Laserdisks cost approximately $3,000 to master and about $8 to replicate. DVDs currently cost approximately $3000 to master and about $2.40 to replicate. Since DVD production is based mostly on the same equipment used for CD production, mastering and replication costs should drop to CD levels. Pre-mastering costs are mostly for authoring systems and encoding systems which cost hundreds of thousands of dollars, but these too will get much cheaper in the next few years. There are several which will be on the market in the spring of 1998 for approximately $10,000 for both Windows and Mac platforms.

Conclusion

Clearly there are numerous possible benefits offered by the marriage of DVD and video-case methods of instruction. Much more video can be stored on DVD than laserdisk or CD-ROM. Unlike the laserdisk, the DVD does not need to

be flipped-a small but significant inconvenience to the user. And finally, the video and audio quality on DVD is superior to any form of playback form of data storage. Viewing video representations of interactions in a classroom must be as crisp and clear as possible in order to truly benefit from the viewing experience. At the moment, the widespread use of DVD for videocase methodology is limited by cost. However, as is typical of technology, the costs of creating a DVD for educational purposes may soon decrease while the potential value and use of DVD for educational purposes, particularly in well-designed instructional support programs, will surely increase.

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Factors that Affect Cooperation, Collaboration and Communication in Educational Multimedia Design Teams

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Collaboration, cooperation and communication in educational multimedia design teams is the focus of this paper. In the business arena, multimedia design teams have been used extensively over the past decade to develop software for commercial purposes. In educational settings, however, most courseware has been developed by individuals who, for the most part, do not have the wide range of skills needed to produce a quality product. By working in multimedia design teams, educators can combine their skills to produce both a worthwhile and well-designed piece of software expressly for their educational setting. This study reports preliminary findings about critical factors that promote and facilitate collaboration, cooperation and communication between members of design teams. Factors that discourage or contribute negatively to group interaction and production were also considered. Methods employed included pre- and post-team surveys, peer reviews, participant interviews and journals, and observations. Participants were graduate students in two sections of an instructional technology course, CUIN 7327, the Design and Development of Instructional Packages during spring semesters, 1996 and 1997.

This project fits into a larger research focus on educational multimedia courseware development and authoring competencies for educators. Although multimedia design teams in commercial settings have been the focus of many recent articles in business publications, there is little research-based literature about teams composed of educators developing courseware. In order for multimedia design teams to work together effectively, members must possess effective and well-developed skills of collaboration, cooperation and communication. Understanding how these skills may be developed and nurtured plays a critical part in courseware development and may facilitate a more effective model of instruction.

Educational Multimedia

Using the computer to control and deliver a full range of audiovisual media offers educators a way to regain the power and strength of audio, video, animations and interactive simulations, and to build those features into educational materials. These materials actively engage students by giving them the best possible presentation and explanations with whatever media are the most suitable to the task. Interactive multimedia implies multiple forms of communications media, controlled, coordinated and integrated by the computer. The computer allows the individual user to interact with and control the flow of information. Instead of reading the information in a conventional linear way, the user is encouraged to pursue links from one topic to another following a uniquely personal trail through the information. The user becomes an active participant in the flow of the narrative, actively choosing material, and in some cases, modifying the content itself to suit his or her needs and interests.

In the past few years there has been a dramatic growth in the interest and possibilities of using multimedia in educational settings (Ferretti, 1993). However, Wiburg (1995) noted that although there are thousands of articles about multimedia, there is very little research. In addition, Wiburg continued, much of the research that does exist about multimedia has been conducted in other areas and is peripheral to the concerns of most educators.

Effective Use of Technology

There are many viewpoints on the competencies that educators need to effectively use computer technology in their classrooms. Teacher education organizations have proposed that educators should have, "The ability to integrate instructional technology into the classroom to facilitate interdisciplinary teaching and learning, supplement instructional strategies, design instructional materials, and enhance hands-on experiences and problem solving" (National Council for the Association of Teacher Education, 1992) and "demonstrate knowledge of uses of multimedia, hypermedia and telecommunications to support instruction" (International Society for Technology in Education, 1992). D'Ignazio (1993) stated that multimedia has a great

potential for educators at all grade levels by bringing even "the driest areas of curriculum to life" and by turning the classroom in "an exciting studio-like area" (p. 490).

Authoring Courseware

Lockard, Abrams, and Many (1994) listed several reasons why teachers may find it advantageous to develop their own software. First, teachers may not find appropriate software. Educational software companies must develop software that meets the needs of many students in order to be cost-effective. Second, budgetary considerations may prevent teachers from purchasing a commercial software package. Third, educational software is not designed with specific students and individual needs in mind. Finally, teachers may have a personal preference for creating their own materials including the natural desire of experienced teachers to produce their own educational materials of all kinds.

Teachers are logical developers of courseware for their classrooms. They have a better knowledge of the content than do commercial software designers, and they bring to the authoring environment their knowledge of good pedagogy and teaching skills. Teachers also have the concrete experience of actually teaching the content. They have learned by experience what strategies work and which ones must be reinforced in multiple ways. Teachers understand the needs of their audience better than anyone else. Many teachers may actually prefer to develop their own materials just as they do with other classroom materials such as handouts and worksheets. Kearsley (1986) suggested that teachers should author their own programs in order to become better software evaluators. He stated that the ability to distinguish a good software program from another is one of the critical skills needed by software designers. He continued by adding that evaluation skills and design skills are mirror images of one another. Finally, teachers are the ultimate users of the software.

As early as 1984, researchers have cited the need of some teachers for producing their own software and have contended that software development is a valid topic for teachers to study at the graduate level (Young, 1984; Monahan, 1987; Overbaugh, 1994). In addition, Turner and Dipinto (1992) stated that hypermedia gave students new insights into writing. Using hypermedia caused students to view information as more than large streams of text, but more as chunks of information that were linked. Turner and Dipinto reported that the study indicated that "the time students invest in learning to use software and hardware not only gives them a powerful new medium of communication but may also give them new insights into organizing and synthesizing information" (p. 198).

Multimedia Design Teams

In spite of these compelling reasons for educators producing their own courseware, it is not reasonable to expect that educators will be able to produce professional looking courseware taking into consideration both the limitations of time and production capabilities. The range of skills needed to produce a multimedia project include a detailed knowledge of computers, information processing, graphic design, sound and video editing, and instructional design. It is practical, therefore, to view the development of educational courseware much like the development of commercial software utilizing the concept of multimedia design teams with specialists in the various production fields.

A design team usually consists of several individuals with specific talents who contribute in some way to the development of a shared goal. Martin (1995) stated: "A team refers to a small, tightly knit team of people intensely focused on meeting a specified objective that all members of the team are committed to accomplishing together." (p.65)" In a successful and effective design team, each member feels a sense of trust, commitment, and responsibility for other members and a shared vision for team goals and objectives.

Multimedia design teams are, for the most part, organized around a project manager, an instructional designer, a graphic artist, an audio and video producer, a content writer and a programmer. Working for a client, the team develops learning materials that may include some form of computer-assisted software program, a manual or guide and a set of usually print-based teacher materials.

One of the most important factors in a team approach to courseware design is the interaction and communication among team members (Ally, 1985). Team members are required to work cooperatively and must learn to function as a unit. In spite of areas of specialization, team members must be able to communicate ideas and meanings effectively. As illustrated in Figure 1, there are many possible channels of communication.

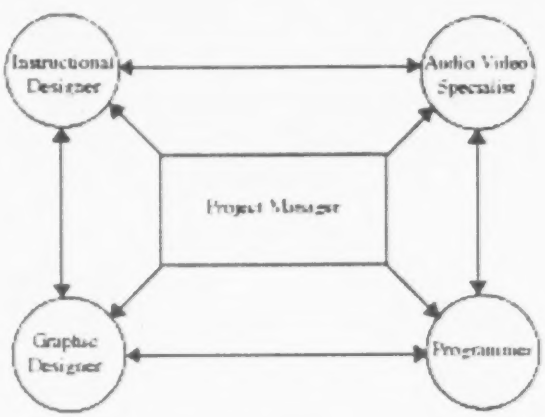

Figure 1. Team Communication and Collaboration.

In the business field, design teams may spend several sessions learning to work collaboratively. Unlike the highly structured procedures of cooperative learning, a collaborative learning environment empowers the learners to actively seek knowledge. Teams become more autonomous as they learn to work, interact and nurture each other while working toward the team goal. Bouton and Garth (1983) cited the fact that through a collaborative learning situation, the learners are transformed from spectators to being involved in more complex interactions in an active learning process.

This study investigated some critical factors that enhance collaboration, communication and cooperation among team members developing educational courseware. This research has implications that will impact both students and faculty in the design and development of educational multimedia courseware. Current trends in educational research indicate that the delivery of multimedia materials will increase over the next decade.

Research Design

Objectives

Goals for this study included:

1. determining those behaviors which promote group cooperation and those behaviors which contribute in a negative manner to teamwork
2. soliciting from participants ways that positive behaviors may be learned and developed
3. examining solutions to problems which occur between members of a team
4. creating guidelines and suggestions for promoting positive team interaction
5. suggesting what role previous team experiences may have on group communication and behavior

Procedures

Procedures included a detailed literature review concerning effective team qualities in multimedia design teams including those used in the business field, pre- and post-team surveys, peer reviews, participant interviews and journals, and observations. Participants included 42 students in two graduate instructional technology courses, CUIN 7327, the Design and Development of Instructional Packages during spring semester, 1996 and 1997.

The research plan began with an initial assessment of computer skills, multimedia skills and knowledge of team strategies based on two surveys completed by students the first night of class. The Computer Skills Assessment (Figure 2) asked students to rate their skills in such areas as proficiency in specific types of software programs and the ability to use hardware peripherals such as scanners and digital cameras. The Multimedia Skills Assessment (Figure 3) asked students to rate their skills in areas such as the use of specific authoring programs such as Macromedia Authorware and Director.

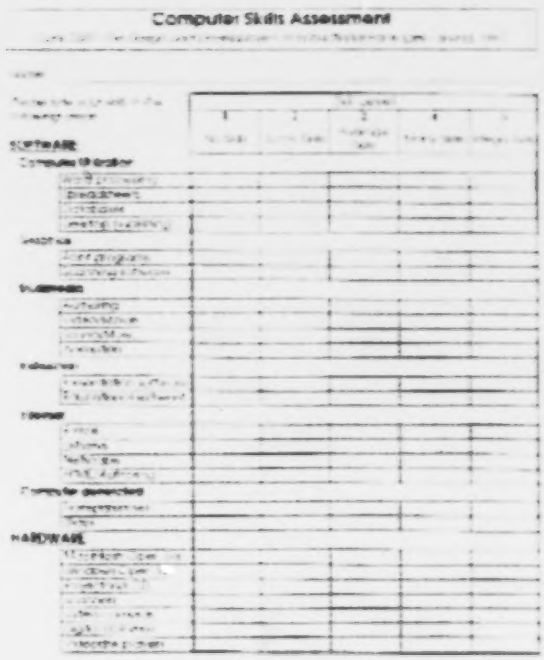

Figure 2. Computer Skills Assessment.

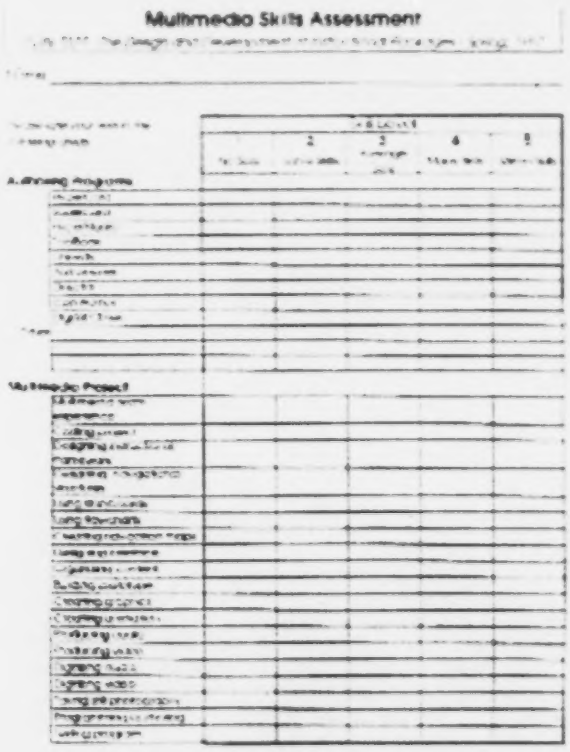

Figure 3. Multimedia Skills Assessment.

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In addition, this survey asked students to rate their multimedia project experience in such areas as designing navigational structures, building a prototype and producing video.

Design Teams

Based on this survey and student interviews, each class was divided into design teams consisting of the following members: a project manager, a graphic designer, a videographer, a programmer and a content writer. During the 1996 semester, four teams of five members each worked with a different client to develop a multimedia project according to that client's specifications over the course of the fourteen-week semester. During the 1997 semester, four teams worked on different sections of a large project for one client. The purpose of this project was to provide students with an introductory, but realistic, experience in developing a piece of software in a team environment.

Design Process

Students were assigned to different teams based on the skills analysis they completed on the first night of class and the instructor's knowledge of each individual's background. For the most part, students in this class had completed both the introductory instructional design course and overview of multimedia course.

The next few class sessions were spent on discussing team roles and developing competencies that would allow students to complete their part in the projects. Teams also met with their client to discuss and develop preliminary analysis and goals for the project. Students soon realized that working in a team and trying to develop a piece of software for someone else is a lot of work.

Communication began to develop both in class team meetings and through email. One student noted: "I remember all of us being polite to each other at first. However, we had a lot of creative work to accomplish and 'polite' wasn't exactly what I had in mind from this team. But as soon as we got to know each other, our meetings became more open and lively." Another member of the team reflected," I found these discussions, sometimes heated ones, to be thought provoking and interesting. Ideas were put forth, discussed and then tested for consensus. We tossed a lot of ideas back and forth while we were trying to visualize how this product should look and what was needed to make it a reality."

In addition to communication skills, one student noted in his journal, "I've noticed that listening skills are especially important on a project team ... there are times in our groups where people don't stop to listen to each other's ideas and it really slows progress as we discuss (debate) a single item over and over. It's much easier when everyone takes a turn speaking, others listen, the issue is out on the table and a decision is made."

Some problems were encountered when quiet students were reluctant to voice their opinions: "I believe other (students) have been frustrated or have kept quiet because of the vocal nature of a few members of the class."

Teams also foundered a bit at first trying to develop ideas and models for their projects. Members soon realized that decisions should be made by the team and not by individuals. It took most of the teams several weeks of meetings both as a team and with the client to develop a plan and direction for the projects. Some team members noted that success was related to early decision making, "We had to 'start from scratch' a few times, but those times were well justified - and were team decisions. It took us about two weeks before we settled on a direction. And we did not make a major change after that point."

Some teams spent several sessions establishing team rules for discussion; this usually facilitated decision making and communication. Although University of Houston graduate students usually work full time and often commute as much as an hour to come to class in the evenings, team members met many meeting requirements by using email.

Many students felt apprehensive about time considerations, working in a team situation and being evaluated by their peers rather than just the instructor, "I fear that the amount of time needed for production will be very demanding. The team process and work is worth the course alone! I'm learning tremendous lessons. It is also a very positive experience with each problem, group interaction, individual interaction building a team spirit. I like this!" A student remarked, "I think everyone is 'nervous' because the expectations of the finished product is high – everyone wants to create something really good."

Student Resources

Several different types of resources were available for student learning. These included the textbooks, *I Sing the Body Electronic* by Fred Moody and *Multimedia Making It Work* by Tay Vaughn. In addition Web pages for each class were developed and used as means for sharing information and progress on the projects.

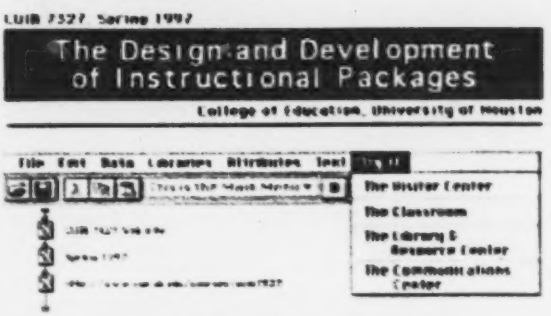

Figure 4. Web Site for CUIN 7327.

Several students remarked on the Web pages in their journals noting, "The web pages have some interesting links and the material is organized in a logical and consistent

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fashion... The pages are a good way to stay connected to the class when at work or at home - important in creating a 'community' because of job or personal schedules."

To access the pages used during spring, 1997:
http://www.coe.uh.edu/courses/cuin7327

Project Presentations

At the end of each semester, team members demonstrated their final projects in a special evening presentation. Although the content and quality of each project differed greatly, the goals of the class were clearly met - students experienced working in an authentic learning situation. Several teams exceeded expectations in functioning as a cohesive unit noting," own weight and did not depend on someone else to do their job. We functioned as a team and not a collection of individuals. Our group rose to the highest definition of a team."

Preliminary Findings

A mid-semester and final survey on Project Team Attitude was completed by each member anonymously. This survey has been adapted from relevant surveys used in business (Systems One, 1996). In addition, students participated in both mid-semester and final peer reviews. Peer reviews asked students to rate such competencies as "Quality of Assignments," "Responsibility to Team," "Contributions to Team," "Attitude," "Teamwork," and "Overall Team Member" for each member of the team and to also rate themselves. Comments at this time included, "My group is very eager and positive – we feel a sense of 'group.' I still think we're showing our best selves – will be interesting as the timeline nears."

Direct observation of team meetings and interviews with team members were also conducted by the researcher at critical milestones for courseware development over the course of the semester. In addition, team members were also required to keep journals of their thoughts and feelings during team meetings and other development opportunities.

Midterm Evaluations 1996

Participants used a likert scale to rate their perceptions of their team health and well-being. Using a scale ranging from 1 – strongly agree to 5 strongly disagree, participants responded to such statements as:

- The goals of the team are clearly understood by team members.
- Team meetings are productive.
- I feel that I have been an important part of this team so far.

The highest disagreement among all teams was shown on statements such as, " The team is using their meeting time effectively." and " The team is learning to effectively address and resolve problems within the team." The most agreement among all teams occurred on such statements as, " The team is developing effective strategies to meet objectives." And "Team members are making efforts to get jobs completed." The ratings ranged from 2.65 to 1.85. These collective results were shared with the participants and strategies for facilitating better interaction and problem solving were addressed in a group discussion. At this stage in the project, there was a steep learning curve and many problems were being worked out, both with the clients and between team members. The overall attitude of the project teams ranged from 4 responses of excellent, 6 responses of very good, 4 good, and 4 fair.

Final Evaluations 1996

Similar evaluations were completed at the end of the semester. As in the midterm evaluations, one of the highest areas of dissatisfaction among all teams continued to be, "The team is learning to effectively address and resolve problems within the team." The most agreement among all teams occurred on such statements as, I feel that I have been an important member of this team so far," "Team members are making efforts to get jobs completed," and "Team members have been generally positive in their outlook regarding the project." The ratings ranged from 2.09 to 1.52.

Figure 5. Peer Review Form.

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Peer Reviews

Peer reviews (Figure 4) asked students to rate such competencies as "Quality of Assignments," "Responsibility to Team," "Contributions to Team," "Attitude," "Teamwork," and "Overall Team Member" for each member of the team and to also rate themselves. Consistently across all teams, team members rated their other members above average on most categories.

Discussion

Although many components of this research are still being evaluated and researched, it seems from a preliminary investigation that the areas of communication, collaboration and cooperation in a team environment are rich in experiences and nuances. Successful teams, as demonstrated in both project development and peer reviews, were able to work together and resolve problems quickly without any single person assuming a dominant or overpowering role. Teams that experienced some dissatisfaction with the team process typically did not form a cohesive group or work together to solve problems that arose. Although a leadership role is expected of the project manager, successful teams clearly developed a process for equal participation among team members. Further research is needed to explore other influences such as time constraints and different skill levels among members.

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PRESERVICE TEACHER EDUCATION

Section Editors:

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Integration" still seems to be the leitmotiv of most reports this year and probably the most sought after goal in current teacher preparation programs. Effective infusion and integration of technology in preservice teacher education are quite challenging undertakings as has been well documented in several papers submitted to this section. You will find papers here addressing the integration of technology into specific subject area courses, into methods courses, and others addressing infusion of technology across the curriculum. Some suggest specific approaches and others raise interesting questions regarding the perception students might have as to why technology should be integrated into the curriculum. Is the danger real that students might believe that technology does relieve them of their responsibility for learning foundational skills as reported by Edwards and Mosley? Progress on one dimension sometimes might lead to unanticipated negative consequences in another unless those involved grasp the complete picture and act accordingly (Wellburn, in press).

In order to achieve successful infusion of technology into teacher preparation, and in order to meet recommendations and standards laid out by ISTE/NCATE and other professional organizations, our profession has decidedly moved in the direction of curriculum renewal. Not surprisingly, several examples of curriculum renewal and reform at various institutions are described in this section at this time as well.

A third, very strong theme which emerged from this year's submissions is the social constructive perspective shared by several instructors/researchers who believe that learners build a knowledge base through personal experience, exploration and reality construction. At a time when technologies become available which allow interaction and group collaboration, the constructivist environment is becoming more and more an appropriate educational consideration. The concepts espoused by most teacher preparation programs are in alignment with a constructivist viewpoint allowing students to "learn how to learn."

Finally, the section concludes with some wonderful thoughts on the building of virtual communities. No doubt, our field and seemingly the whole world, has gone "virtual"! Consequently, new "virtual communities" are being created which obey their own rules but also share underlying principles and characteristics with traditional communities. If we want these communities to stay healthy, take on their own life, and serve a purpose, it is essential we learn about them and consider the nature of these new communities which are being created for the purpose of learning, or other endeavors.

Enjoy the readings.

Integration:

a. in specific subject areas Cooper (Texas Tech University) describes a course in Research and Evaluation in which written and electronically generated portfolios are compiled by preservice teachers and compared. Edwards (Purdue University) and Mosley (Bennett College) describe a "tests and measurement" course which attempts to increase preservice teachers' higher thinking skills. Students' perception of the use of technology differed from the instructors' expectations. Jinkerson (Northern Michigan University) discusses the planning stages of a block format of elementary methods courses with a technology course in order to integrate the technology with the subject areas. Omoregie & Coleman (Jackson State University) describe a project to infuse technology training into core academic subject areas. Tejada (University of La Rioja, Spain) provides a critical analysis of the application of technology to music education.
b. into methods courses. Prouty & McGrew-Zoubi (Sam Houston State University) describe efforts to have student teachers apply previously acquired technology skills to the implementation of a "methods" class. Shi, Ren, & Ma (Beijing Normal University) relate the development and implementation of Computer Assisted

Lesson Preparation System (CALPS) software for student teachers. Drier (University of Virginia) describes using manipulatives and a computer program to explore the concepts of probability, randomness and graphing in a mathematics education methods course.

c. across the curriculum. Maney, Perry, Brooks, & Foss (Miami University) discuss TEAM, their approach to beginning teacher technology preparation. They emphasize integration of needs-based technology training and real-world connectivity with inservice teachers. Maney & Brooks (Miami University) focus on alternative evaluation procedures to measure the effectiveness of one of the components of TEAM. Persichitte (University of Northern Colorado) describes the methods of a case study research project to investigate examples of "best practice" in the use of educational technologies in teacher preparation.

Curriculum Renewal

Bao, McKeel, & Stafford (Shippensburg University) describe an Urban Education Initiative and its multimedial presentation. Koenke (University of Illinois) describes an innovative program for elementary education (the Year Long Program) which has served as a pilot for redesigning the entire student teaching program. Powers (Indiana State University) describes how the ISTE/NCATE standards are being implemented and how they have been used as the basis for development of eight technology proficiency examinations for student teachers. Snider & Gershner (Texas Women's University) describe the curriculum renewal research project developing at TWU to align technology preparation efforts for student teachers with the NCATE recommendations. Waugh, Levin, & Buell (University of Illinois) discuss the development and implementation of a WWW-accessible Technology Competencies Database used to support student teachers' development of electronic portfolios illustrating mastery of the ISTE/NCATE standards.

Social Constructive Perspective

Edwards, IlChul Ahn, Mooney (Purdue University) describe how two computer labs were reconfigured to provide more "cognitive learning exercises" by using "scenario-based activities" in which students cooperated and came up with solutions/approaches to issues of management and instruction, in order to facilitate students' thinking about real applications of the technology. Ferdig (Michigan State University) suggest the use of a "story-based approach" to replace the more typical skills-based one, in which think-aloud protocols are used to help students develop their own realities about the connection between teaching and technology. Halpin (Mississippi State University) explores the use of the constructivist approach to learning technology and describes a program model which encourages exploration and discovery. Topper (Michigan State University) finds that the dialogue between instructor and learner takes on different dimensions when conducted within the teaching model that considers teachers as adult professionals who have their own ideas about teaching, learning, and technology.

Virtual Communities

Nonis, Bronack, & Heaton (University of Virginia) offer suggestions for building a "virtual community", based upon experiences gained in creating such a community for students at the Curry School of Education.

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Electronic Diagnostic Portfolios: Advantages and Disadvantages of this Technological Approach

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There is a current trend toward the integration of technology into instructional practices. What are the advantages for teachers in using technology? Mathies (1994) pointed out that technology can be employed by both the student and the teacher to improve performance and instruction. It is possible for teachers to enhance their instruction and attempt to lessen their workload by taking advantage of the capabilities of various technologies.

Purpose of the Study

The new elementary education program in a College of Education at a large university offers a course for undergraduates in Research and Evaluation. As part of this course, teacher education students collect elementary student work and develop a process of analyzing this information to make instructional decisions. In the section taught by the instructor/researcher, teacher education students are required to complete a Diagnostic Portfolio of the elementary student work analysis. In addition, this section focuses upon the integration of technology in the research and evaluation process. The combination of the two brings forth a research proposition for the instructor/researcher. What if the Diagnostic Portfolio were created and presented on the computer?

In this project, teacher education students will (1) design and create Diagnostic Portfolios either electronically or written, and (2) present Diagnostic Portfolios for peer and instructor feedback and to determine advantages and disadvantages of the two formats.

The data collection for this project attempted to answer the following questions: (1) What processes are required in designing and creating a Diagnostic Portfolio in a written format and in an electronic format using the computer? (2) What are the advantages and disadvantages of creating Diagnostic Portfolios in a written format or an electronic format using the computer?

Rationale

Chambers and others (1992) encouraged modern electronic classrooms to "block out outside stimuli and present situations as realistically as possible short of the use of virtual reality; thus projecting students into meaningful situations in which learning occurs faster due to the focus of attention." Some advantages and disadvantages of teachers using technology for elementary student analysis could be determined from factors presented in the data collection and analysis of this project.

Relevant Literature Review

A short review of literature on the topic of elementary student analysis in the form of electronic portfolios indicated a lack of studies and information in this area. However, many analysts have recommended portfolios as a mechanism for integrating learning and assessment (Schon, 1987; Gardner, 1989; Wolf, 1989; Collins, 1990; Pearlman, 1991; Belland & Best, 1992; Paulson, Paulson, & Meyer, 1991). Pearlman (1991) reported that some Maine schools are piloting the use of computers and multimedia to develop "electronic portfolios" of K-12 students' work.

McLellan (1993) described diagnosis as dynamic and on-going. The teacher must analyze at every moment the progress of the learners and adapt or customize the methods and other conditions of learning to meet the emergent needs of the learners. She indicated that diagnosis is based upon many kinds of information, including portfolios, summary statistics, and the teacher's continuous assessment of the learner's progress.

These two approaches provide a starting point for exploring new kinds of evaluation that are needed to support a new model of learning. McLellan (1993) recommended that additional research is needed to develop and refine instructional practices and technological tools that serve both a learning and evaluative function.

Data Collection

Teacher education students enrolled in a section of the Research and Evaluation course during the Fall semester, 1996 were the subjects of this study. All teacher education students were involved in the process of creating Diagnostic Portfolios as a requirement of the course, however, volunteers were sought to participate in the development of Electronic Diagnostic Portfolios by using the computer.

Informal interviews were conducted with 3 teacher education students from each group of participants which included the group who created written Diagnostic Portfolios and those who created Electronic Diagnostic Portfolios. Questions used during the interviews were developed to determine the process each group experienced during the semester as they created these Diagnostic Portfolios. These interviews were conducted at the end of October, 1996 and were audio-taped and transcribed for analysis.

t the end of the semester, all teacher education students presented their Diagnostic Portfolios to the class. At the conclusion of this presentation session, the teacher education students were asked to reflect on their processes of completing these Diagnostic Portfolios and compared their products with each other through discussion and a written survey. This presentation/reflection session was video-taped and transcribed for analysis. The written surveys were collected and analyzed qualitatively.

Data Analysis

A qualitative approach was used for the data analysis in this project. The transcription of the interviews were analyzed according to the delineation of categories that emerged from the statements made by the teacher education students about the processes involved in creating a Diagnostic Portfolio. The transcription of the video-taped discussion was analyzed according to the delineation of categories that emerged and identified as advantages and disadvantages (by being positive or negative in connotation) of the two formats used in creating Diagnostic Portfolios.

Data analyzed from the interviews and video-taped discussion indicated the advantages and disadvantages of using electronic portfolios. The results are given in Table 1.

Conclusions

Using Electronic Diagnostic Portfolios was a unique and intriguing approach for the students in this class/study. Many were excited about the prospect of learning more about using technology, especially since they anticipated expectations of using technology when entering the classroom as teachers. However, in this process, there was a realization that using technology is more that just an innovative action, it is an extensive task.

In order to fully implement a system of electronic portfolios, a careful evaluation of equipment needed, software necessary, and available assistance is mandatory. In addition, teachers should start small (with a few students or with a few inclusions) and pilot this implementation to work through problems and to practice applications.

Future Directions

Reporting assessment information to Parents in an important part of effective communication for classroom teachers. Developing a Diagnostic Portfolio for Parents could potentially serve classroom teachers well in presenting and sharing significant information about children in their classroom. However, in view of the results of this study, we need to consider the following questions. Is it effective to use the computer in the development of Diagnostic Portfolios? Is this a beneficial tool for classroom teachers? Would classroom teachers have the time to develop Diagnostic Portfolios for the children in their classroom?

Many educators are embracing the effort to integrate more technology. Before this big step, there needs to be careful consideration of the needs of those involved and the availability of equipment and materials needed to fully implement the technology.

Table 1. Advantages and Disadvantages of Electronic Portfolios

Advantages	Disadvantages
Electronic Portfolios can be stored on a computer diskette and this takes up less space in the classroom	Scanning student work, pictures, etc. is difficult when the appropriate equipment and/or assistance is not available. In addition, scanned work requires lots of memory and cannot be easily saved on one computer diskette.
Information can be easily retrieved from the computer as you can "click" from one screen to another, as opposed to "flipping" through pages.	It is difficult storing a lot of information on a computer diskette.
A variety of formats can be placed on electronic portfolios that are more easily accessible and easier to share with parents. For example, photographs of student projects, video clips of group work, audio clips of a student reading, etc.	Inclusions of various formats requires specific equipment, special expertise, and a larger capacity for storage.

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If I Teach ... With Technology, They Will Learn! But What?

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Is the notion that teachers will teach the way they were taught compelling enough to motivate those in higher education, who teach pre-service and in-service teachers, to change their instructional methods to use and model the use of technology (Baumbach, Kysilka, and McLain, 1989; Diem, 1989; Rutherford and Grana, 1995)? The answer for many may still remain something other than an absolute yes or no, even when (with all things being equal) the instructors possess all the necessary knowledge, positive attitudes, and skills to accomplish the task, including good, solid, computer skills. Less than a decade ago, one of the original arguments for inclusion of computers in educational environments was that "computers increase student engagement, add realism to instruction, promote skill mastery and understanding of principles, augment laboratory experiences, and encourage inferential thinking" (Johnston and Joscelyn, 1989, p. 2). Today, it remains one of the leading arguments promoting inclusion of computers in the curriculum.

One would get very little argument in suggesting that any good instructor enters the classroom well prepared to facilitate the learning process without technology. Therefore, with technology (and the technology of choice being the computer), that same instructor will in all likelihood be willing and eager to move students to a higher level of thinking and learning. The expectation is that by engaging students with computers, they will develop and demonstrate better problem solving skills, better analytical skills, better critical thinking skills, and better decision making skills ... and the emphasis here is on the word "better." But is this the perception students have as to why technology, and in this case the computer, is being integrated into the curriculum?

A Case For Integration

The instructor at a medium-size, southern university was excited about the prospects of teaching a Teacher Education core course, Tests and Measurements, to pre-service and lateral entry in-service teachers. Supposedly, students were not allowed to take Tests and Measurements until their junior year, however, from time to time, special arrangements were made for outstanding sophomores. The possibility for adding a technology component to satisfy state mandated computer competencies was second only to the vision of restructuring the course to include (a) more group activities in which objectives would be written and matched to test items prior to test taking, (b) weekly "easy, nonsense" tests for data collection, analysis, and understanding of key concepts, e.g. reliability, validity, test-retest, equivalent forms, and (c) various ways of scoring and grading tests including the weighted method and use of the mean score. The technology component, as originally designed by the instructor, included the use of two computer applications, one simple to use statistical shareware package and SPSS for Windows. Presuming that students would have spent one semester crunching numbers in a basic statistics course, moving them to statistical packages would consolidate time, allow for more in-depth analysis of concepts, and facilitate the use of critical thinking skills during classroom discussions. And to get them accustomed to the weekly "easy, nonsense" tests which would be given during the first three weeks of class, the instructor took the 2 through 12 multiplication tables, eliminated the duplicates, and excluded all numbers times 1. A total of 66 multiplication items were then randomly assigned to two test sheets, each containing 33 multiplication table items.

A Method To The Madness

During the first day of class, Fall 1995, a syllabus was distributed, and the students were given in-depth information on the course, especially the use of "easy, nonsense" tests for data collection. The "easy, nonsense" tests would consist of information the pre-service and in-service teachers would have learned no later than the 5th grade, thereby a non-threatening environment in which to learn testing concepts would exist. And because each student would be taking the "easy, nonsense" tests, a sense of ownership would encourage participation for understanding test construction and test results. The intent was to facilitate

each student's understanding of testing and to hammer home the point of test analysis and interpretation. Each week, students would be responsible for answering the question, "What do the test results mean?" and each student would analyze his or her own individual test score in isolation from class peers, and then, his or her own individual test score in relation to the entire group of test takers.

Following the distribution of the syllabus and detailed explanations of the course, a short survey was distributed and collected to gather basic information on each student. Then, the first "easy, nonsense" test of multiplication table items was distributed face down. Students were made to feel at ease and it was reiterated that the "easy, nonsense" test had nothing to do with the grading system for the course. This first "easy, nonsense" test would be a timed test and students were to complete, to the best of their ability, as many multiplication table items as possible in 30 seconds. Prior to giving the "begin" signal, students were given an opportunity to ask questions. The only question that was asked was, "Can we use our calculators?"

Of the 74 students enrolled in Tests and Measurement in Spring 1995, 48 were present on the first day of class. Scores from the first "easy, nonsense" tests ranged from a low of 8 to a high of 30, with a mean score of 16.1 and a standard deviation of 3.8. Students not present on the first day of class were not allowed to make up the first "easy, nonsense" test, however survey data was obtained. Of the 74 students, 46 were females, 27 were males, and 1 was unclassified. Fourteen were lateral entry teachers with graduate student status, 39 were seniors, 14 were juniors, 3 were sophomores, and 4 declined to classify themselves. Fifty-two (70.3%) of the 74 students had never taken a single statistics course. And to the dismay of most of the students, they were not and would not be allowed to use their calculators for any of the "easy, nonsense" tests.

What Do The Test Results Mean?

According to the data obtained the first day of class, the concept of the "easy, nonsense" tests of the instructor quickly turned to a myth. Even though the first "easy, nonsense" test consisted of items from the 2 through 12 multiplication tables, students felt 30 seconds was inadequate for good performance. Additionally, they attributed any less than desired performance on the restriction of the use of a calculator; and because the students felt attainment of a high score was impossible, anyone scoring 30 was accused by the majority of the test takers of cheating.

Problem?

Students were advised of their raw score at the second class meeting and informed that the second "easy, nonsense" test of multiplication table items would be administered in two weeks. A strong suggestion to review the multiplication tables was made by the instructor. On the designated day, the second "easy, nonsense" test of multiplication table items was distributed face down. Students were made to feel at ease and it was reiterated that the "easy, nonsense" test had nothing to do with the grading system for the course. Prior to the "begin" signal, students appeared somewhat anxious. So in an attempt to relieve some of the anxiety in the classroom, students were advised that they would be given 35 seconds to complete the test instead of 30. Of the 74 students enrolled in Tests and Measurement in Fall 1995, 64 were present for administration of the second "easy, nonsense" test of multiplication table items. Raw scores ranged from a low of 12 to a high of 33, with a mean score of 21.6 and a standard deviation of 5.7. Forty-three of the original 48 students who took the first test were present for the second testing. As a single group, their raw scores ranged from 8 to 30, and yielded a mean score of 16.0 with a standard deviation of 4.0 for the first test; and for the second test, raw scores ranged from 12 to 33, and yielded a mean score of 22.1 with a standard deviation of 5.3.

A Possible Problem

There may be a very serious problem ... a problem which was tracked with the help of the Educational Media Specialist from Fall 1995 through Summer 1997 via a number of the "easy, nonsense" tests. Because the Tests and Measurements course was meant to utilize statistical means for assessment, math-based "easy, nonsense" tests were used, both timed and untimed. And with each administration, more problems were uncovered. And the problems were not limited to the "easy, nonsense" tests. Problems surfaced on the survey which solicited basic student information. Each semester, students were specifically asked to provide their height in inches. Too many refused, crossing off inches, and substituting their height in feet and inches. Some admitted they did not know, noted such on their sheet, and left the answer blank. Others tried to figure out their height, but bizarre answers were the result, e.g. 2.5 inches, 4, inches, 5 inches, 144 inches, 300 inches. Students may have simply forgotten how to do basic math or the severity of the problems could mean that students lack mastery of foundational math skills generally taught prior to or no later than 5th grade.

More Problems

The multiplication table items and the conversion of feet to inches were not the only problems. In subsequent semesters, a number of other "easy, nonsense' tests were administered. The following items were extracted from sites on the World Wide Web and incorporated into two of the numerous "easy, nonsense" tests.

1. Question: Divide 30 by 1/2. Add ten. What is the answer. ____
2. Question: The price of an article was cut 20% for a sale. By what percent must the item be increased to again sell the article at the original price?

   15% 20% 25% 30% 40%

Both represent somewhat problematic items, however, they were specifically selected for that reason. They would lend themselves quite well for discussion of problematic test items due to wording. But the wording of the items were not the problem. Question #1, a fill-in item, was incorrectly answered by most students who thought the answer should be 25. The wording of the item was not the problem. They seemed baffled by the explanation to "invert the divisor." Question #2, a multiple choice item, was incorrectly answered by most students who thought the answer should be 20%. Once again, the wording was not the problem. Students were shocked at the logic that to increase the article to its original price, the percentage must be higher that the percentage to cut the price.

Even More Problems

These problems were not limited to any one semester. They were recurrent every time the course was taught from Fall 1995 through Summer 1997. There is an old saying (author unknown) which goes something like this: "The first time it happens, it is a accident; the second time it happens, it is a coincidence; but the third time it happens, it is a habit." Unfortunately, every semester most of the students consistently had problems completing the "easy, nonsense" math-based tests which consisted of items no later than 5th grade level. Table 1 documents the original problem over multiple semesters as identified by the instructor from the very first day the course was taught. Only the Fall 1995 students were given 35 seconds for the second administration of the multiplication table items, however, all students were strongly encouraged to review their multiplication tables prior to the administration of the second test.

Addressing the Problems

It is more than reasonable to assume that pre-service and in-service teachers, who rank as juniors, seniors, or graduate students in college, should know basic math skills. Or is it? If not, how will they conceptualize the sum of the squares versus the square of the sums for calculating standard deviation. The "easy, nonsense" test results were an indication of a more serious problem ... a problem which might travel with pre-service and in-service teachers as they entered the K-12 school systems ... a problem serious enough to be addressed immediately.

Remediation of basic math skills in higher education was prerequisite instruction for the Tests and Measurements course from Fall 1995 through Summer 1997. What originally was to be three weeks of basic statistics instruction consistently turned into three weeks of math remediation including the memorization of the multiplication tables. A total of 346 students took the course over a period of four full semesters and two summer sessions. The data changed very little from semester to semester, with additional math deficiencies surfacing with each new "easy, nonsense" test. Over the two years the instructor taught the Tests and Measurements course, almost 60% of the students entered without ever having taken a statistics course. And because a basic course in statistics was not a part of the Teacher Education program, most left with no intention of ever doing so.

One focus of the course was to provide a foundation for interpreting standardized tests results. Each test item was reviewed and explanations provided as to why the correct answer was indeed the correct answer. Most students felt the missed questions were trick questions. The truth was that the correct answer required higher level thinking skills. Whereas some students were able to make the connection, others simply dismissed the issue feeling that they simply were not good test takers.

Table 1.
Statistics For Multiplication Tables Tests

	Test 1				Test 2			
Semester	**N**	**Mean**	**SD**	**Range**	**N**	**Mean**	**SD**	**Range**
Fall 1995	48	16.1	3.8	8-30	64	21.6	5.7	12-33
Spring 1996		*******Data Missing*******			49	22.9	5.1	10-33
Summer 1996	25	18.4	6.6	0-30	28	22.0	3.8	13-28
Fall 1996	67	18.2	5.4	6-31	66	21.7	6.7	8-33
Spring 1997	58	18.5	6.5	6-31	64	18.5	5.1	5-27
Summer 1997	22	17.1	4.9	8-24	21	22.0	5.4	11-29

And What About Technology Integration?

The integration of computers in the course was well received by the students because most were "fearful" about math and the computer seemed to solve that problem. The technology component was altered somewhat to eliminate the use of SPSS for Windows which was above the heads of most of the students. A gradebook program was substituted in its place which satisfied the computer competency requirement and simultaneously gave the students a more down-to-earth experience in assessment. However, too many students entered and left the course believing that technology relieved them of their responsibility for learning foundational skills. Others quickly came to realize that sometimes technology will slow you down, especially when taking a timed test, and that the best of all worlds is to know ... really know the material. And equally importantly, some began to understand at least one possible reason for their less than desired performance on standardized tests.

It was encouraging to see the students anxiously await their group's turn to process the data, e.g. mean, median, mode, and standard deviation, on the computer. But it was sad watching them try to proof the answer for the standard deviation ... even after the computer supplied them with the basic elements for calculation. It is possible that some might perceive this two-year situation as an isolated case ... or even one which suggests more technology inclusion (probably computers) in the curriculum, especially to address the issue of remediation. As strange as it sounds, it is a success story with a very strange twist. The instructor and Educational Media Specialist are still very excited about teaching ... and will continue to teach with technology ... because they believe students will learn ... and that in time ... rising to a higher learning level will become a reality. But more importantly, both will continue to take a closer look at the attitudes of students when technology is integrated into the curriculum, because learning is also about change.

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Blocking the Education Media & Technology Course with Methods Courses: An Experiment

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Northern Michigan University

Beginning with the Fall 97 semester, the Department of Education at Northern Michigan University, located in Marquette, Michigan, started a block of elementary education courses. Included in this block of courses were: ED 310 Elementary Social Studies Methods and Materials - 2 credit hours, ED 311 Language Arts Methods and Materials for Elementary Teachers - 3 credit hours, ED 316 Elementary Reading Foundations I - 3 credit hours, ED 361 Special Education and the General Classroom Teacher - 2 credit hours, and ED 483 Educational Media and Technology - 2 credit hours

The result is a total of 12 semester credit hours. This allowed students to take an additional content area course in addition to the block for a total of approximately 16 semester credit hours. The recommendation was made to students that they should register for each of these classes. ED 311 and 316 had been field based in Whitman Elementary School of the Marquette Area Public Schools for the past several years. In addition, a pilot blocking ED 311 and 316 with ED 310 had been implemented a couple of semesters earlier and continued. The addition of ED 361 and ED 483 to this block was meant to provide an integration of concepts from 361 and 483 into the 310/311/316 methods courses. This paper will discuss the planning stages for this blocked semester, the Fall 97 semester's implementation, the Educational Media and Technology component, and plans for the Winter 98 semester.

Planning Phase

Under the suggestion of Dr. James Hendricks, Head of the Department of Education at Northern Michigan University, four faculty members of the Department (Dr. N. Suzanne Standerford, Associate Professor of Language Arts; Dr. Lorana A. Jinkerson, Associate Professor of Educational Technology; Dr. Laura Hoffman, Assistant Professor of Language Arts; and Dr. Laura Reissner, Assistant Professor of Special Education) began discussing the possibility of blocking their courses for the Fall 97 semester. The suggestion from Dr. Hendricks came partially in light of an agreement between Bay de Noc Community College located in Escanaba, approximately 70 south of Marquette, and Northern Michigan University to begin articulation of course work that would allow Bay de Noc students to take 3 years of teacher education coursework at Bay and reside at Northern for the methods phase of their teacher preparation, essentially 2 semesters, and then return to the Escanaba area to complete the program through their student teaching experience.

Another concern that had been plaguing the Department was the separateness of many of our courses. The Department wanted to model to our prospective teachers not only how to work together, but also how to teach thematically through the integration of several subjects. Specifically, the following background was presented to the group as a basis for this work: the Department of Education faculty develop for and with prospective teachers and professional communities of practitioners the"norms" of the best possible K-5 teaching and learning practices; to the preceding end, the Department practice as a community of professional educators, e.g., capacities for "team" decision-making and instruction; and, the faculty develop as they proceed principles to guide their pedagogy and to guide the development of their content, e.g., "inquiry-centered" principles for teaching and learning together (faculty, prospective teachers, classroom teachers, administrators, K-8 learners, et al).

There was some apprehension among the faculty about ED 483, a new Educational Media and Technology course, that had recently been made a requirement for graduation. The Department did not want the course to be focused on just the "how to operate computers" or "how to run a specific program". Rather the desire was that this course model to students how technology supports learning in all content areas. As a separate course, this was proving difficult. Likewise with ED 361, Special Education and the General Classroom Teacher. Each of these courses had developed a "technology of the week" or "disability of the week" format and students saw little connection to content and felt very frustrated trying to do assignments with no content focus or authentic utilization.

Other than some beginning discussion meetings held during the Winter 97 semester, the planning stages were conducted during the Spring 97 semester and continued through the Summer 97 semester. The four professors involved in these five courses and a group of professors who would later comprise the second semester of the block (e.g. math methods, science methods, children's literature, elementary reading instruction II) met formally four times over the course of the spring/summer to plan the block. The first meeting was an all day meeting. The other three were half day meetings. The Department paid a stipend to each participant for their time on these planning days.

The first meeting began with the general question, "To what extent can we develop and model a collaborative learning community which reflects: an integrated approach to learning and curriculum; a supportive learning culture within which students develop agency, reflection, collaboration, and culture; time for students to reflect and think more deeply about their learning experiences; and, assessment of common professional traits and qualities of students across courses and tasks."

Each professor listed the goals and objectives of their separate courses in the hopes of identifying common outcomes. Some of these included portfolios, lesson plans, walking journals of field experiences, e-mail projects, reading of children's novels, attending professional meetings, writing, weekly news logs, case studies, reflective articles, materials production, software utilization, software evaluation, and information access on the World Wide Web. A unifying theme was for the students to see the connection between "what they're seeing, what they're reading, and what they're doing."

The group discussed textbooks and other resources in an attempt to utilize some materials across the courses. In addition to reducing the amount of reading students would need to do, freeing up time to read more in depth and critically, dual use of materials would save students money. The faculty shared their separate syllabi from the previous Winter (97) semester and looked for ways to rearrange and/or combine topics to support one another's work. Using these syllabi, each faculty member made a list of their requirements, looking to consolidate assignments across two or more of the courses. Assignments were listed in three categories: blocked assignments, possible blocked assignments, and individual assignments for specific classes. Finally each faculty member revised their syllabi according to the topic schedule discussed and assignments to be shared.

At the final summer meeting of the block faculty, plans for the first day of classes were made. The overall goal was not to have all faculty attend all course times, but rather to have each course taught by the appropriate faculty member in a supporting capacity to the others. However, the decision was made that we would all meet with the group of students the first day of classes to explain the goals and working arrangements of the block. It was further decided that we would all meet a couple of times over the course of the semester with the students. Class lists were compared and notations of which students were actually enrolled in all five courses were made. Since this was a new program, some students had already taken one or more of the courses we had blocked together. Hence, there was not 100% overlap. The students in ED 310, 311, and 316 were all the same, but those in ED 361 and ED 483 were not. Overall, there were 13 students in all five courses. It was the hope that the Winter 98 semester would have a larger number of students enrolled in all five classes, and indeed the registration lists for the upcoming Winter semester support that goal. We predict that it will take approximately two years before all the students are in all courses of the block.

Implementation Phase

All four instructors attended the first meeting of the ED 311/316 class. Syllabi for all courses were distributed and an introduction to the concept and goals of the block was presented. Students were encouraged to provide feedback throughout the semester on this experimental program. Time was given for student questions.

The faculty had one meeting at approximately mid-semester to discuss how things were going, changes to make, and what needed additional work. Overall, the general impression at that time was that all was going well. There had been some glitches to work around and details to decipher, but all faculty had received positive feedback from students. At this meeting, 2 more sessions with all faculty present with the students were planned. The first was intended to be a feedback session, giving students a chance to address their thoughts, concerns, and suggestions for the remainder of the semester to all faculty at once. The final meeting between all the faculty and the students would be a time the practicing teachers with whom the students were doing their field experiences could express their thoughts, concerns, and suggestions. Both of these sessions were well received. Both students and practicing teachers verbalized their extreme satisfaction with the program, offering only a few suggestions for modification and/or improvement. Feedback from the students highlighted the collegiality of working together as a cohort across the classes, the ease and support of working with all four faculty including our flexibility in regards to assignments supporting several courses, and the connectedness of all to authentic practice.

Some typical student comments include: I think the block classes have been a great success and I would highly suggest to other students who will be taking their methods classes soon to enroll in the block courses; About the block classes, I love them. I really have a great time and I am learning so much. Actually I come home some days with a headache because I have so much new information in my

head; We do have our rough weeks but we all manage to get through them. I feel I can talk to or call anyone of you (meaning the faculty) at anytime and that goes the same for the students - we are so close. I've never had a class where the students and teachers were so close before; I think all the classes are going very well and I am getting the most out of them. They are really interesting and keep me on my toes. I am never bored; All of my concerns were brought up in the discussion we had last week which by the way was very good to have. It gave us all a chance to sit down and talk about our concerns as well as what we liked; I really enjoy being part of this block and it is a very good idea to have it. Thanks for giving me the chance to be in it.

Media and Technology Component

The majority of assignments in ED 483, Educational Media and Technology, were planned to be completed as part of a requirement for the other courses. There were only four assignments that were exclusively for ED 483. In previous semesters all assignments were completed solely for this class. As ED 483 had not previously had a field experience component, working with the other blocked courses that did have a field experience allowed the inclusion of assignments taking advantage of this experience. A concerted effort was made to integrate and support assignments in the other blocked courses with technology so students could apply the technology ideas in authentic teaching tasks. Prior to this arrangement little technology integration was taking place in the other courses. The following partial list of assignments for ED 483 illustrate the interrelationship of the assignments with those of one or more of the other courses.

Audio Tape

Select a poem or story to record with appropriate background music. May be combined with writing and performing poetry for ED 311/316 and/or social studies poem for ED 310.

Concept Mapping

Design a concept map with the Inspiration program or other drawing program for the Rainforest Packet assignment (ED 310) or for ED 361 as instructed by Dr. Reissner.

Database

Design a News Log database with a minimum of 8 fields and 5 records for keeping track of your new stories for ED 310. Insert a header and/or footer labeling with your name and the assignment title. Print the database in list form, landscape mode. Sort the database on any one of the fields, change the heading and/or footer identifying what field it is sorted on, and print again.

Graphic Flyer

Use a program on a computer such as The Print Shop, a word processor or presentation program to design a handout, poster, or flyer you might use in a class. Include both text and graphics. This should follow all the design guidelines discussed in class as to text, graphics, and color. It must support one of your block assignments - suggestions include lessons, cover page for your portfolio, etc.

Hypermedia

Using a hypermedia package such as HyperStudio, HyperCard, or Linkway, design a project to support the novel you read that compliments Sing Down the Moon., or a ED 361 project as defined by Dr. Reissner. Other possible connections can be discussed with me prior to execution. A minimum of 5 cards is required. All design issues discussed in class should be considered. Incorporation of scanned image, Internet image, digital camera image, original computer graphic, etc. is encouraged.

Internet Graphic

Locate and save on your disk at least one graphic from the Internet to support your portfolio, word processing, hypermedia, presentation, overhead transparency, newsletter, graphic flyer, lessons, etc.. It must support one of the projects for the block classes. Be sure to jot down the address and date you downloaded the graphic. Convert to PICT format with the GIF Converter program. Resave on your disk. Finally, utilize the graphic in another assignment.

Internet Resources

Locate a minimum of one Internet site that could be used in conjunction with the Rainforest book, for your News Log, your American history characterization, with the story Sing Down the Moon, or with one of your lessons. Print out the Internet page, being sure the http address and the date of the printout is included. Write a paragraph explaining how the information will be used in your project.

Professional Development Event

Attend one professional development event such as Upper Peninsula Reading Association Annual Conference October 9 and 10, Seaborg Math and Science Conference October 10, a NMU SMEA meeting, a Marquette-Alger Reading Council (MARC) meeting, etc. Show proof of technology focus to get credit for ED 483.

Technology Lesson

Choose one or more of your lessons you plan for any of the block classes but integrate technology into the execution of the topic at hand, whether reading or social studies. Discuss with me your ideas before you implement. Think of all the various technologies we are covering this semester and which would best support the content you are trying to teach. Identify which of the State of Michigan K-12 Technology Outcomes are supported by your lesson.

Walking Journals

Using groups selected in ED 311/316, set up an e-mail discussion list to act as your walking journal of your field experience assignment. Include comments for all block classes. Be sure to include all faculty in your list so we get a

copy of your log. For ED 483 specifically, respond a minimum of 3 times over the course of the semester noting technology observations - include VCRs, overhead projectors, computers, video camcorders, recorded audio, the Internet, CD-ROMs, e-mail, teacher utility programs, etc. Some possible questions to think about and respond to include: What technology is being used? Who is using the technology? What is being done with technology? How do the students react to the technology compared to similar non-technology work? What pieces of technology are in the classroom? How much technology is available in the classroom? Do you see ways the teacher could utilize technology in non-technology lessons? If so, what and how? If computers are available, how many students work on one machine at a time? Do you see differences in classroom organization and/or structure when technology is being used? If so, what and how? Do you see changes in student behavior when technology is utilized? If so, what and how?

A web site was set up for students in the block which included the syllabus, a listing of all assignment requirements, detailed instructions for producing them, and exemplary examples of each.

Revision Phase

As the end of the Fall 97 semester is upon us, the faculty are contemplating revisions for the Winter 98 semester, taking into account final comments to be collected from the students during exam week. These revisions will be discussed during the presentation and will also be available on the web site: http://www.nmu.edu/staff/ljinkers/BlockW98.html

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Technology Infusion: The Impact of Technology Infusion in Creating Quality Instructional Materials

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In the Summer of 1996, Mississippi Institutions of Higher Learning funded a proposal for the Jackson State University's School of Education to implement the Technology Infusion Project for core academic subjects. The Project staff developed and operated a comprehensive multimedia computer training program to enlighten the participating School of Education's teacher education preservice teachers on how to deliver instruction in English, the arts, geography, math, science, and history by utilizing technological tools. The Project goals and objectives were as followed: (1) to enhance preservice teachers with the knowledge of modern technologies that will enhance curricula in English, history, the arts, geography, math, and science at the K-12 level, and (2) to facilitate practical knowledge about technology infusion. The major objectives were to: (a) provide two weeks of intensive multimedia computer instruction to 20 selected preservice students during the 1996 summer semester, (b) provide 20 preservice teachers with knowledge on integrating modern technology in English, history, the arts, math, science, and geography curricula, (D) facilitate a structure for focused electronic discussions between the instructor and project participants, and (d) provide information on developing materials for English, history, the arts, math, science, and geography by using technological tools.

In order to serve twenty of the School of Education's preservice teachers in the twelve-month granting period, the School requested funds from Mississippi Institutions of Higher Learning. Throughout the Fall of 1996, the TIP project staff continuously monitored the participating preservice teachers during their practical teaching experience to ensure that technology was being integrated in their daily classroom activities. Finally, the participating preservice teachers were provided with E-mail addresses to communicate with the faculty at the University while on practical field experience.

Research on Technology

As we approach the 2 1 st century, technology must become the driving force in the delivery of instruction to today's youth. Since the birth of microcomputers, the education community has recognized that redesign of teacher training is essential to the successful integration of technology in classroom instruction. While much has changed over the years, the need for teacher support and training has not. These components remain the key to successful implementation of technology in the classroom.

In schools across the nation, teachers continue to use calculators to average students' daily test grades, and they continue to create lesson plans and homework assignments for students through the use of freehand. With today's technological innovations, teachers should have skills that will enable them to use new innovations such as multimedia computers, digital cameras, scanners, in focus video projectors, in focus LCD panels, CD-recorders, video conferencing systems, and numerous software packages; i.e. Hyper studio, PowerPoint, Word Perfect, Netscape, and Microsoft works, to name a few. Many educators fear making massive investments in technological training. Their prior experiences with educational reform have led them to believe that the "new" revolution in computer use will pass in a few years like the so many other "new" revolutions in the past. As Decker Walker wrote:

> It is impossible to predict how long computers-in-education will hold the spotlight of public and professional attention. Five years would be an excellent run; 10 years would be the best since progressive education. What concerns me, however, is not the length of the run but what will remain in the schools when the boom has run its course and a new act has captured the spotlight. When that happens, the fate of computers-in-education will depend on the instructional uses to which teachers and students can put their computers (Walker, 1983, p. 244).

Still others fear that the emphasis on technology may overshadow important efforts to develop basics in math, reading, communication skills, and science. In reality,

technology and the new demands of the technological age should lead educators to redefine these cherished basics and the ways in which they are taught. A considerable body of research has already revealed that computer technology can enhance the learning skills of at-risk students by developing critical thinking and problem-solving skills, as well as, encouraging collaborative learning. Further, systems can be implemented to facilitate interaction among parents, teachers and students; an outcome already known to improve school performance (Poirot and Canales, 1993; Norris, 1994; Poirot and Robinson, 1994). Nevertheless, the collective fears expressed by too many educators may partially explain an observation made by Gwen Solomon of the US Department of Education: "technology is everywhere but in the schools."

The reluctance of teachers to fully commit themselves to becoming technologically literate must be addressed. For the public schools, teacher involvement is the key aspect for successful technology infusion process. After all, it is the teacher who develops and implements the actual lesson plans for classroom instruction. As such, the advice of Abrams and Many (1997) seems particularly relevant:

> Teachers who have not yet decided to adopt technology personally should continue to be exposed to the possibilities, gently encouraged, and offered support; but, their participation cannot be forced. More will result from supporting the willing than from cajoling the reluctant. To try to interest reluctant colleagues, inquire as to the areas of their teaching that cause them the most difficulty. Explore the potential for technological intervention. If there is an acknowledged problem, that teacher may be more willing to consider a new approach. If not, try again next year. (p.377)

On a broader scale, successful integration of technology in the delivery systems of public schools will require support from the district office in a number of areas. These areas include technology coordination, planning, integration, teacher involvement, staff development, hardware configuration, facilities and funding for successful implementation of technology infusion (Lockard, Abrams & Many, 1997). Successful coordination of technology literacy programs in schools requires effective leadership to provide training seminars for classroom teachers and administrators. Teachers will also need access to resource persons in the district. Even with training needs and administrative support, teachers do not have the time to create individualized tools or make new technologies possible. Teachers may possess general ideas regarding these areas, but a specialist can help the teachers put their ideas into practice, either by creating software applications or by customizing existing technologies. Infusing technology in a school curriculum requires a carefully developed plan that includes a long-term view involving factors such a system-wide applications and major involvement of teachers/administrators (Lockard, Abrams & Many, 1997). One can not overlook the importance of articulation across grade levels because each teacher needs to know what students have previously learned to effectively plan for his/her own grade level. Finally, on-going staff development, appropriate hardware/software, appropriately equipped facilities, and adequate funding are all needed in any plan for successful technology infusion in the schools.

Method

The project was designed using the following phases: preservice teachers training workshop, and district students exposure program. The phase one entailed introducing 20 twenty program participants to the technology based training program developed to achieve the project goals and objectives. The technology based program entailed the following: Infusing Technology into the Classroom; Integrating Technology into English, reading, mathematics, science, and other core Curriculum; Introduction to Networking Systems (Windows NT & Novell NetWare*); Publishing an Interactive Multimedia Project; Image Creation; Word Processing, spreadsheet, & Database; Using Telecommunications tools in Education. After the preservice teachers had received instruction from the faculty involved in the project, they were asked to develop a multimedia project to represent their areas of specialties.

The final phase entailed the delivery of the technology based instruction in the classroom by the preservice teachers to students in the district schools. The preservice teachers utilized technological tools and materials which they were exposed to in delivery instruction in the following areas: English, math, science, geography, history, and arts. Periodically, participants were supervised and evaluated by site coordinators assigned by the director of Center for Excellence in Education in the School of Education.

Equipment/Software used for the Project

The project facilitators and preservice teachers employed the use of the following equipment: Networked Multimedia Computers, Digital cameras, scanners, printers, QuickCam Technology, Infocus Video Projectors, Infocus LCD Panels, Overhead Projectors, Presenter Tview, Television Sets, Sony CD-Recorders, Personal Video Conferencing System, File/Video Servers. HyperStudio, PowerPoint 7.0, Microsoft Works 4.0, Word Perfect, Student Writing Center, Microsoft Explorer, Microsoft Front Page, Windows NT, Novell NetWare, and Macromedia Freehand were used by faculty and preservice teachers during the two week session. Finally, for transmission, ISDN/telephone lines, and T I connections were used for equipment connectivity.

The research design employed in the study was descriptive in nature. Based on the review of literature, the

researchers found no satisfactory instrument which met the requirements of this study. Therefore, a Likert Scale was developed to measure responses. According to Kerlinger (1973), developing a Likert Scale requires that numerous statements concerning the interest, attitudes, values or other personal characteristics are gathered. Statements developed representing relevant aspects of the variable to be measured were selected using expert judgment and testing with appropriate respondents. Five researchers determined whether a positive or negative response would be scaled higher. However, after the consideration of the aforementioned reasons, an evaluation instrument with twenty four questions was developed and administered to twenty project participants. The instrument addressed the importance of technology infusion in course curriculum such as math, history, arts, English and geography.

Due to the research component included in the project, the following questions were examined:

(a) does technology infusion play a significant role in developing quality instructional materials?
(b) does technology infusion play a significant role in the academic performance of students?
(D does technology infusion play a significant role in the preparation of preservice teachers?

Results

In analyzing the preservice teachers' responses and the data of district school students academic performance, the analysis revealed that technology enhanced following:

- Increased interaction between students and preservice teachers.
- Increased academic performance of students and preservice teachers.
- Increased computing skills of students and preservice teachers.
- Increased motivation of students and preservice teachers.
- Encouraged rapid feedback between university faculty and preservice teachers.
- Encouraged rapid feedback between teachers and school district students.
- Increased students' interaction using the electronic mail enhance their writing skills.

In response to the three research questions, (a) does technology infusion play a significant role in developing quality instructional materials? Based on the data gathered, 95% of the preservice teachers agreed that technology infusion plays a significant role in developing quality instructional materials for school aged students and adults. (b) does technology infusion play a significant role in the academic performance of students? Based on the analysis, the academic performance of preservice teachers and students increased by 75% in core academic subjects. 0 does technology infusion play a significant role in the preparation of preservice teachers? Based on the data analysis, 100% of the participants agreed that technology infusion plays a significant role in the preparation of preservice teachers.

Implications

The evaluation results of twenty respondents revealed positive perceptions of technology infusion core academic subjects. The study calls for further consideration that would allow the analysis of the perceptions of inservice and preservice teachers after the completion of similar technology training workshops. Consequently, it is evident that technology infusion as well as other technology application should be implemented in higher education and k-12 levels.

Equipment and software acquisition, faculty support, administrative involvement, and staff development are very important in the successful implementation technology infusion in the classroom. The research revealed that "Train-the-Trainer" model would be the best way to transfer technology from higher education to k-12 classrooms across the nation. In the State of the Union of January 23, 1996, President Clinton stated that he would ask the Congress to support the education technology initiative which calls for every classroom in America to be connected to the superhighway with computers, good software, and well-trained teachers. However, the success of the aforementioned initiative lies on the improvement of teacher education program across the nation.

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Music Technology and Multimedia as a Music Educators' Tool

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Even if a child of this age could abstract and understand certain aspects of writing and reading music, we believe living the music with all the body must be a fundamental and more important objective than providing him or her with theory and musical literacy through technology. The child needs live, sensory based experiences on which to build knowledge and skills and that will permit him or her to develop cooperation, solidarity and a respect for values. Music education has a strong socialization component, which must be developed through relationships with other individuals, not next to a machine. But computers and digital instruments can be behind them, manipulated by the teacher, bringing them a greater timbral wealth than the one which customarily exists nowadays in the music classroom; giving them, through the compositions and arrangements accomplished by the teacher, a rhythmic guide for the pulsation that helps them develop their internal pulse, as well as a guide for the intonation.

This way, it is possible to work with music in a progressive manner with more difficulties added at each surpassed phase, according to a didactic principle which will offer them the possibility of assembling their proposals in collective compositions and release music class time which can be used by the teacher for greater intervention and interaction with the children.

Electronic instruments, computers and music software are potent and useful tools for the Music Educator. Music technology helps teachers in the elaboration of sound and written materials that will help the children move, sing, perform, dance or improvise, whatever the methodological approach the educator uses.

From the perspective of the integration of music technology in the Music Teacher curriculum, there are two conceptions: as a tool for the future Music Teacher and as a reinforcement of pupils' apprenticeship. Because it constitutes a very useful instrument for the didactic elaboration of music materials, it is a teaching tool. Music technology acts as a graphic and sound support in a predominantly active teaching environment in which classic elements of movement, speech, song, dance, improvisation, performance and dramatisation play a very important role. It is a useful apprenticeship tool because it provides training elements, permits immediate hearing which musically can be imagined, facilitates the approximation between abstraction and reality and aids in the acquisition of certain procedures related to the areas of Composition and Instrumentation.

In this work, we will do a critical revision of the uses of Music Technology, its application in Music Teacher Education and its possible applications in the classroom, specifically in compulsory education.

Music Technology and Multimedia in Music Teacher Education

Generally musical teaching, at least in its first levels would be fundamentally practical. This would be particularly true of offerings by universities in the training of music specialist teachers. General Psychology, the different Didactics or the different subjects inserted into the curricula of Primary Education would be applied by the future music teacher in his or her future professional context. If the music teacher, however, wants to make the best use of the contents and adapt these at the level of the group class, they will also need to apply the practical harmonisation, arrangement and instrumentation knowledge in order to elaborate his or her own didactic materials. In this manner, the teacher can be creative with the work, whether it is with simple melodic lines, popular songs or collective and individual compositions.

In first instance, the acquisition of the abilities and skills cited is the objective of Functional Harmony. This is the University of La Rioja's course where the knowledge of both managing of musical data processing and music technology is inserted (Tejada, 1997). Functional Harmony is an obligatory subject ; it has 4.5 credits corresponding to the second course of the Music Education Teacher studies plan. With the amount of time available we take a predomi-

nantly practical approach where the acquisition of basic skills and abilities outweighs the learning of concepts and theoretical elements. The heterogeneity of the group, seen in the general lack of previous musical skills with which the pupils enters into these studies, is a second reason for applying a practical approach.

Functional Harmony consists of two differentiated parts though very imbricated. The first one, Foundations of Harmony, is approached through theoretical notions related directly with harmonic discipline, that is to say, construction, operation, relationships and chord links. Within this part exist some areas related to the Composition and Instrumentation that imply the creation of works and arrangements, constituting a hidden part of the curriculum.

In the other part, Musical Informatics, the contents deal with the communication between computer and MIDI devices and the managing of scores publishing programs such as Encore, sequencers, Master Tracks, and algorithmic programs such as Band in a Box. Music technology is used to form the harmonisations that the pupils create and permits them to explore in an intuitive way the parameters that the composer uses. With such technological tools, the pupils individually create popular song arrangements. In addition, they compose in groups while taking into account Didactics of Music.

Another important technological element used in Functional Harmony is the multitrack recorder device that has been employed for the first time in this academic year. The multitrack is used to record group compositions created by the pupils using real Orff instruments and, eventually, with some digital sounds. This is also used to record the musical arrangements accomplished for the subject Agrupaciones Musicales (Musical Groups). With a multitrack recorder, the pupils knows and approach the various problems brought up during musical performances in real time (i.e. timing and syncronization) and those which generate the accomplishment of a good recording (i.e. equalization, panning, mixing, etc.).

During the last two academic years we have been looking at the scarcity of previous training of the pupils that enter into this career. I have decided to use a series of aural training practices with the computer which employ a training program, Practica Musica, as a reinforcement of the apprenticeships in certain specific subjects: Lenguaje Musical, Formacion Vocal y Auditiva, Formacion Ritmica y Danza (Musical Language, Auditive and Vocal Education, Rhythmic Education and Dance). These practices are accomplished at the margin of those credits assigned to Functional Harmony. This includes the establishment of a second part of this subject as well as the implementation of such auditive education activities in the compulsory and obligatory subjects mentioned earlier.

The Internet, through E-mail lists, plays a complementary role in the subject in serving as a liaison with other foreign educational centers to exchange didactic materials elaborated by the pupils with both digital instruments and computers. These materials go from a simple melody to complete arrangements or arrangement sketches that modifies the pupils' criteria. This active exchange of music materials helps us understand the differences in the music of other countries. The elaboration of this type of materials increases our knowledge of appropriate compositional techniques.

Music Technology has also been used in the preparation of both graphic and sound materials in the training of the future Early Childhood Teachers, Foreign Language Teachers and Physical Education Teachers, as well as in other subjects used in Music Education. The technology gives graphic and sound support during predominantly active teaching in which classic elements of movement, speech, song, dance, improvisation, performance and dramatization play a very important role. The teacher elaborates the sound materials and the pupils play, dance, sing and improvise on them. At the present time, there is a permanent seminar made up of music education teachers from all levels of teaching, whose objective is the creation of music educational materials with the help of technology.

Educational Multimedia

Nowadays, there exists a broad offering of courses, congresses, seminars, workshops and publications on multimedia and educational technology. Unfortunately, fewer of these possibilities are found in the actual classroom. Many teacher educators continue to believe that their work is reduced to the transmission of knowledge which their pupils collect. Even though some are using educational technology, too many continue in their old attitudes concerning the teaching-learning processes.

Some teachers who support the use of technology still disregard certain necessary processes before its integration which can result in forced implementation. While examining curricular blocks in which to introduce the technology, they attempt to insert technology in places where it might have the best or most striking results, when indeed we must reflect upon the role that technology is going to have in the educational intervention.

Multimedia can help some students to surpass their inertia such as that of taking notes from teacher's lectures. This can eliminate the boredom produced by the mechanic repetition of exercises focused on acquiring aural skills or instrumental performance skills. This can be a motivational aid for the pupils. Thanks to its special treatment of the information, multimedia can "hook" pupils in the exposition of specific contents. It also facilitates the exposition of key issues regarding given topics and makes the question-answer strategy more dynamic (Barajas, Simo, 1994). For example, a video sequence inserted into a computer program can demonstrate a real orchestra with its instru-

ments, its placement, its timbres, the musical arrangement, etc. This can be more motivational for the pupil than teacher's words or the isolated sound of a cassette or disk.

The creation of a multimedia musical project need not be very complex nor costly, given the existing authoring tools currently on the market. This would permit us to adapt and personalize the instructional contents that we make available to our pupils. Educational multimedia in CD-ROM constitutes a magnificent resource at an educational library. The pupils can use it for looking up information in order to elaborate their work. In this way, technology reinforces the apprenticeship of a given topic (musical analysis, history of the music, musical forms, organology, etc).

At the University of La Rioja, we are using certain multimedia titles for the subjects Audiciones Musicales Activas (Active Musical Auditions) and Historia de la Musica (History of the Music) as a multimedia support of master classes. Such is the case with The New World Symphony, by A.Dvorak, Dissonant Quartet and The Magic Flute, by W.A. Mozart, Ninth Symphony, by L.Beethoven, Guide to the Orchestra for Young People, by B.Britten or So I've Heard, a recompilation of music and information from different historical eras.

A Critical Point of View

A recent virtual conference carried out on Internet[1] outlined the possibilities that would exist if music technology had a role in elementary music education.This topic has provoked a strong dissent among the presenters. Leaving aside the difficulties of forming the nuances of the discussion, I will attempt to condense the main contributions, which, in my opinion, constitute the synthesis of what currently is thought about technology in music education.

Doug Goodkin, a known specialist in methodology Orff,[2] was against these technologies arguing we spend our lives working to understand what the body, the voice and the imagination can be capable of making. Furthermore, we have limited musical instruction time throughout the primary stage, a short period in which to communicate to the students our knowledge of music as well as our love of this art form. Goodkin ask a number of questions: Is it worth the time that is devoted to learn the operation of the system, the time employed in teaching it and the time that is not devoted to something else? Can we justify the monetary investment in a computer in order to obtain the supposed quality from presentation when there is not even money to pay the music specialists that are needed in the schools? Are the children working about a screen in the same way they would work together in the creation of a dance or music piece? Citing Postman, while simultaneously articulating ideas from Marshall McLuhan, Goodkin asserts that the technologies are not neutral, but have implicit values, educational definitions, implications related to the social and emotional processes, that radically transform to the users without taking into account the content. New technologies are not added to those which came before but aggressively replace them. He also argues about the effect of the large amount of time that the children devote to television screens and the need for a greater relationship to the real world.

Another point of view is presented by musician and programmer Jeff Evans, creator of the auditive training program Practica Musica. He argues that by definition the art is synthetic. The real world is something that each child must experience, but would not have to concern us if the computer eliminates the pleasures of the natural world. The cybernetic world is built with the imagination, an intellectual construction. It has its own captivations which are not the same as those of reality while being themselves no less real. No programmed musical performance can rival the content of a live performance. Hearing one is different than hearing the other. Evans, however, does not reject the use of the ordering when it is applied to those tasks related to the objective of acquiring a deeper comprehension and appraisal of the music. His examples include the invention of new melodies which the students transcribe by hearing and the creation of an endless number of variations of chord progressions for identification. These tasks are more applicable to the education at higher levels than basic teaching but the principle is the same: the computer aids music education, it does not replace it. Therefore, programs could be used outside

the class to help train ears and minds in the purely technical aspects of music in order to take advantage of limited class time. For Evans, the computer is another tool, something else to use.

I share the opinions of Goodkin on music education, but I do not reject those of Evans. From my experience with technological tools in classes for adults, I have found that they are a helpful complement to the acquisition of a series of objectives such as the ability to imagine the music and other aspects related to the music reading-writing.

On the one hand, to experience aurally harmonic exercises through use of publishing score programs in a theoretical way helps the pupils facilitate the approximation of concept and sound reality, that is to say, among elements of the music reading and writing and its sound decoding. To elaborate specific didactic materials with technological tools (play-backs for performing, improvisation and movement, composition of curricular musical materials and popular song arrangements that support the scholarly activities programmed by future music educators provides procedures directly to areas not inserted explicitly into the curriculum of the specialist. This is true in the case of Composition and Instrumentation. Furthermore, they help these potential music teachers while they reflect on the Didactics of the Music, in developing a critical ear in the

election and creation of materials. All of these procurements are facilitated by immediate needs as well as those technologies which can spark the musical imagination as well as the exploration of sound.

Without a doubt, I believe that this is the greater advantage that musical technology provided by musical technology in the training of the future Music Education Teacher. Coinciding with the opinions of Jeff Evans, I see that the auditive training programs can save much of the time dedicated by professors, conservatories and high schools to the monotonous and repetitious tasks that auditive training brings, that is, in the technical aspects of the musical language. During class time, the computer can help pupils to reinforce the concepts given in the classroom, while the teacher can devote the time of class to interact with the pupils, dance, move, play the instruments or sing with them. In this type of program the pupils receive more individual attention.

Nevertheless, I do not see clearly the application of the technological tools in Primary Education as part of children's curriculum. I do not accept the use of the technology with these children because there is a world to discover in an active way before they are drawn into the musical literacy mechanisms, that the technology facilitates. In my opinion, many schools around the world still lack material and human resources to give an adequate musical education and there are still a high number of educational centers that lack instruments or do not have specialists. Even where there are few of the problems of a material type, there are academic difficulties, including the small amount of time devoted to music in the curriculum.

Even if a child of this age can abstract and understand certain aspects of music reading and writing, I believe that it is fundamentally important to live music with all the body. This is a more important objective than providing students with theory and musical literacy through the technology. The child needs some tangible musical bases, lived and sensed, on which to build knowledge and skills that will help in developing values of cooperation , solidarity and respect. Music education has a strong socialization component which must be developed through relationships with other people, not with a machine. Computers and digital instruments can be in the background, manipulated by the teacher, providing a greater timbral wealth than that which customarily nowadays exist in the music classroom. This will give them, through the compositions and arrangements created by the teacher, a rhythmic guide to the pulsation which will help them to develop their internal pulse, as well as a guide for tuning. All of this will make it possible to work on musical pieces in a progressive way, with difficulties added to each surpassed phase, offering the possibility of assembling their proposals in collective compositions. A certain amount of class time can then be used by the teacher for greater intervention and interaction with the children.

Conclusions

From the perspective of school practice, technology is a very useful didactic resource in the music classroom. Electronic instruments, computer and music software constitute potent tools for the Music Educator. That technology will help in the elaboration of sound and written materials that will serve the children while they move, sing, perform, dance or improvise on whatever the methodological approach the educator uses. From the perspective of the integration of music technology in the Music Teacher curriculum, this has two sides: as a tool for future Music Teachers and as an element of reinforcement during the training of pupils. It is a teaching tool which constitutes a very useful instrument for the didactic elaboration of music materials. It is a useful apprenticeship tool as it provides elements of training, permits immediate hearings that can be musically imagined, facilitates approximations between abstraction and reality, and helps in the acquisition of certain procedures related to the areas of the Composition and the Instrumentation.

The elaboration of materials would necessitate the addition of music workstations for the music educator in each center of Primary and Secondary Education. These workstations would, at a minimum, have to consist of a computer, a MIDI keyboard synthesizer, and a score editor program. The keyboard synthesizer would serve not only as part of the teacher's workstation, but would add other instrumental possibilities to the classroom. A device with a very rich timbral range and a source of sound effects can be most helpful in the attainment of various objectives of music education.

Footnotes

1Electronic address: http://www.artsedge.kennedy-center.org/vc/vcmain.html

2Carl Orff was an eminent composer and educationalist. He created in collaboration with Gunild Keetman one of most used active methodologies of music education called Orff-Schulwerk.

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SHOW, DON'T TELL! PRESERVICE TEACHERS GET TECHNICAL

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Preservice teachers excitedly share their e-mail messages from their assigned elementary students with variations of "Look at this question!" to "How will I ever find this information?" These preservice teachers in their Methods semester are exchanging questions and answers with the students from the classrooms where they will soon be teaching. Weekly e-mail messages from third and fourth graders ("What are fish scales made of?" and "Is fog the same thing as a cloud?") send these university students to a variety of sources as they prepare the interchange for their classroom keypals. The immediacy of a young student waiting for a reply offers excitement and motivation (Poling, 1994) as this methods section begins its final semester with university classroom instruction and field based teaching experiences before the student teaching experience.

Felt Need

Although technology projects had emerged in earlier semesters and students were required to participate in a technology literacy course, interview data showed that preservice teachers at this small southwestern university fit into a generalized ratio of 1/3 for each category of experienced, moderately experienced, and inexperienced users of computer technology. With this information and a new computer lab facility, the Methods team of three professors planned technology interactions with e-mail, videodisc, Power Point, and Hyperstudio to prepare preservice teachers to use the technology to implement an integrated six day teaching unit in their public school classroom during the semester. In addition, each preservice teacher used the Internet to pursue information for assigned research papers, for small group papers and presentations over current educational topics, as well as for locating answers to the questions of their keypals.

Another need was defined by the independent school districts who participate as partners with the teacher education program for field based experiences. Representatives from these districts function as a Board for input and planning. These districts had begun to purchase and equip their schools with computers, networks, software, and presentation facilities only to see them used on a very limited basis. Even though inservice had been provided in buildings where the equipment was located, there was ongoing concern from school district representatives that teachers found it difficult to plan and implement appropriate materials for this technology use in their classrooms. The Board requested and fully supported the planned Methods instruction and the field experiences with the strong emphasis for preparing future teachers to access, use, and facilitate the technology that was available in schools.

Theoretical Background

Various research based experiential models of learning (Bandura & Schunk, 1981) support components of motivation, observation, instruction, and presentation as learners acquire new technical skills. In addition, a constructivist approach (Merrill, 1991) to provide levels of assistance as needed to maximize learning, to scaffold, and to operate in the "zone of proximal development" (Vygotsky, 1986) undergirded the instructional team's planning and implementation of the technology goals for these preservice teachers. If a preservice teacher had experienced technology only as an end unto itself in earlier interactions, during the Methods semester, technology use would become a tool for instructional support, hopefully as commonplace and as transparent to the content and skills being learned as a piece of chalk, overhead projection marker, or a transparency.

Demonstrations, Applications

Planned sessions on technology use in the computer lab built upon learners' earlier experiences; however, parameters for the assignments were broad enough to allow the preservice teachers wide variations in their personal interpretations and applications for classroom use. The first aspect of technology to be instructed was e-mail because it would be an avenue of frequent use between the university students and instructors as participants shared reflections about Methods' issues from classtime and field experiences. It was important for preservice teachers to experience e-mail as a service technology for information exchange, much as one would use a telephone. And most were able to do so; however, some still found themselves distrustful enough to share that they kept a hardcopy of each interaction.

The videodisc technology used by students was in the form of Windows on Science by Optical Data, a technology

based elementary science program adopted in local districts. The discs contained single frame pictures and diagrams, as well as very brief film clips. Some of the film clips had audio, but most of the discs did not. A large binder of teaching materials and prepared scripts was available. The materials were adaptable to any grade level by changing the language used in the script at the discretion of the teacher. Although most of the preservice teachers had no experience with videodiscs, they found them quite easy to use and manage. The major difficulty was locating the player and the materials at the schools as most teachers did not use either. Another videodisc program used in elementary classrooms was Science Sleuth by Tom Snyder Productions. This videodisc had a very different presentation mode. Students used a problem-solving approach to a scenario presented early in the disc, and the video stopped periodically to give them opportunities for discussion.

Although most preservice teachers had observed PowerPoint in use, they had not learned how to access it on the network nor how to develop slides for their own purposes. After presentations and experiences in the laboratory, PowerPoint became one component for a Methods class presentation on a conflict area of the world. Next, preservice teachers used the PowerPoint software to develop a lesson or lesson component for their field based teaching in the classroom.

HyperStudio became the required format for presenting a prepared set of mathematics cards for teaching metric measurement in the field based classrooms. Preservice teachers learned to create additional stacks of math cards, as well, and used these with their assigned students.

Assessment

The data from all participants - the preservice teachers, the classroom students, and the public school mentor-teachers - gave evidence of high evaluations of the performance of the different groups. Weekly reflections, pre and post interview data, portfolio assessments, the actual technology products, classroom students' and preservice teachers' self assessments and product assessments triangulate to give valuable in-depth information for ongoing and summative assessments of the technology emphasis in this Methods semester. These process and product data were qualitatively evaluated by graduate students (inservice teachers) and other instructors outside the instructional team with high scores on all measures used - a team prepared Likert-type scale and a program analysis.

Afterward

This major emphasis on the technology component for the Methods semester involves a large segment of the allowable hours within the Methods blocked courses for the teacher-in-training. Also, major logistic planning for use of the computer laboratory for initial teaching becomes a crucial component. The technology emphasis, however, continues to get high priority from the assessments of all participants. The input from student teachers and from the inservice teachers in the field also supports this focus. With major advances in the availability of technology in public schools and in teacher training institutions, our abilities to touch the world and our willingness to do so can only grow.

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Applying Computer in Teachers' Class Preparation Activity

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Computers in education can play a role in helping teachers prepare their class-teaching activities as well as assist or guide the students' learning (Shi, 1995). Much attention has been devoted in recent years to Computer Assisted Learning, whereas less to the Computer Assisted Teaching to a degree. Nowadays advanced information technology, and in particular the computing technology, have been widely accommodated into the pre-service teacher education in China. But there are still a considerable amount of in-service teachers who have only a little, or even no experience working with computers (Shi, 1995). This paper examines the application of a CBE (Computer Based Education) system from the teacher's side and depicts with discussion the effect of one Electronic Class Preparation System that aims to help teachers of the Chinese Language in senior-middle school. The conclusion we drew is that several factors have an impact on one information technology's application and popularization. Among these factors that will have to be considered are (1) the user's (i.e. the teacher's) psychological acceptance to and his or her previous experience with the information technology, (2) the relevance of the information technology in solving specific problems, (3) the cost and accessibility of the information technology.

Introduction

Advanced information technology is currently particularly amenable to use in education and training, as a stage in the development of the technology itself (Cotterell, Ennals, & Briggs, 1988). It is recommended (Owen & Rowlands, 1992) that teachers in the 'information age' should a) make confident personal use of a range of IT devices and key applications; b) critically evaluate applications of IT in their subject specialization; c) plan and manage teaching experiences making appropriate use of IT; d) evaluate the changes in teaching and learning made possible by IT. So advanced information technology needs to be embedded in the whole of a student's experience in teacher education.

In China the term "teacher education" generally denotes the pre-service and in-service education for those who are (to be) teachers. The pre-service teacher education is provided by the postgraduate schools of normal universities, teacher colleges (under-graduate), professional teachers colleges, and normal schools. The in-service teachers can take further study at the teacher's advancement colleges or through radio-TV programs, correspondence courses, TV universities and spare-time colleges.

China's teachers colleges, normal universities and institutions of education train teachers in specialized subject-matter areas generally based on the curriculum of secondary schools. In recent years, there have been great changes in the provision of programs at many normal universities and colleges. In addition to the subject matter areas corresponding to the curriculum of secondary schools, these universities and colleges have also established many new specialized courses, according to the requirements of social development and construction and the growth of science, technology, and education. These new courses are not exclusively designed for training teachers and include such offerings as Computer Science, Radio Electronics, Educational Technology, Information and Library Science, etc (Yang, & Lin, & Su, 1988). These courses are important to help teachers (or tomorrow's teachers) gain the experience of IT usage and then make confident personal use of a range of IT devices and key applications in their teaching career. But we have to point out that although there is some good practice to be found in teacher education institutions, provision is patchy, and that all the elements of good practice were never found together in a given institution. The lack of resources is thought to be a main barrier (The Teacher Today, 1990). Another problem is that tomorrow's teachers are currently being educated (albeit inadequately) in the use of yesterday's technology, and this is clearly inappropriate (Langhorne et al., 1989).

On the other hand, despite the rapid development in the past few years, neither pre-service nor in-service programs of teacher education have meet the needs of elementary and secondary schools in either quantity or quality, while the proportion of unqualified teachers in elementary and

secondary schools is exceptionally high (Yang et al., 1988). According to present regulations, completion of an undergraduate program is the minimum standard for the preparation of senior middle school teachers. However, a large number of schoolteachers currently in the classroom have not met this standard. There is great demand for in-service teacher education at every level.

All in all, the prominent problems in the current teaching staff are low academic degrees, outmoded knowledge, inability to grasp and use advanced techniques and teaching mediums, etc.

Background

The advancement of computing technology gives rise to the performance/cost ratio of the computer, and this in turn has encouraged more and more middle schools in China to establish (micro)computer laboratories. At first computers were mostly IBM/PC 386 or its compatible, which are still in use now. But the majority of computers in middle schools today are PC486 or above. At the same time as the hardware is available, many people realize the need for software or courseware. Teachers and trainers in non-computing subjects have waited for the technology to deliver its promised benefits in a manner that might benefit education and training in their area. Some of them have been disappointed because the results do not live up to initial hopes and expectations. One problem is the common belief that the power lies in the technology, rather than the proper usage (Norman, 1987). Some researchers (Cotterell et al., 1988) have pointed out that in education and training we do not aspire to perfection: we seek to enhance our understanding and that of our students and trainees, equipping them to deal better with problems in the real world. We believe that advanced information technology, and in particular computing science, can offer some powerful new tools with which we can cast new light on old problems in teaching and training (Shi, 1995).

Computers can be used as a teaching resource, which both supposes and facilitates the adjustment of teaching method to the learning processes of pupils. Teachers can use the computer as a tool in their practice. Nowadays classroom teaching is the main organization form in teacher's vocational practice in China. So we believe that the quality and efficiency of the classroom teaching influence the quality and efficiency of the whole education. In order to improve the quality of teaching teachers we must fully prepare each lesson (or lecture). Considering its noticeable ability in information processing it is possible for the computer to play an important role in helping teachers in their classroom in teaching preparation activities. Computers and their applications can also be utilized by teachers to assist with record keeping and paperwork (Langhorne, Donham, & Gross, 1989). With necessary peripherals it can produce some kinds of teaching materials such as handouts used in the classroom, overhead projector transparencies, etc. Furthermore, the computer's large amount of storage capacity and quick information retrieval can provide great convenience to the teacher's looking up of information in their lesson (lecture) preparation process.

Now let's examine a specific example of a computer assisted lesson (lecture) preparation system.

The Computer Assisted Lesson Preparation System (CALPS)

This CALPS is designed to run on the Chinese platform of Win3.x/95. So its appearance and user-interface accord with standard Windows style. This can benefit those users who have experience with Windows applications. The main interface when CALPS has started is shown in [figure 1].

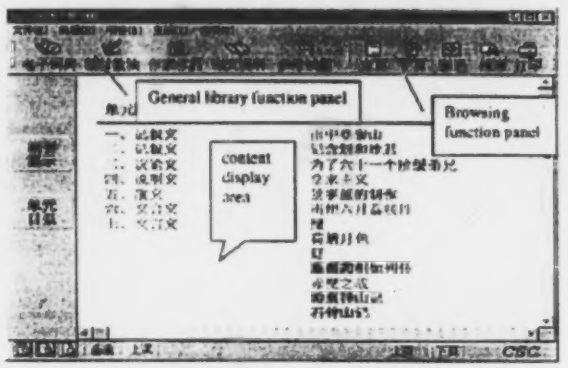

Figure 1. the main interface of the CALPS

The main interface consists of title bar, menu bar, general library function panel, special library function panel, browsing function panel, status bar and content display area. As a whole, the CALPS can be divided into two parts: General Library and Special Library. The General Library is both a toolkit and a database. It provides an Electronic Dictionary that contains about 7,000 common Chinese characters with phonetic alphabet, explanation and pronunciation [see figure 2].

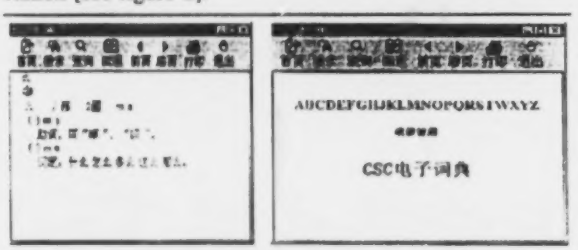

Figure 2. the Electronic Dictionary

The General Library also provides:

- *"teaching materials and teaching method"*which comprises articles about pedagogical theories and contents concerning experts' comments on Chinese Language teaching;

- *"writers and their works"* which contains the works, biography, comments of writers involved in the textbook;
- *"text material"* which contains some versions of Chinese Language textbook used in senior-middle school;
- *"reference examination"* contains large amount of test papers.

The CALPS provides search menu command for the user to navigate the General Library and bookmark menu command to mark up the information found.

The special library function panel has two push buttons. The button on the above leads to the "outline prompt", where the user can read the syllabus, teaching goal, teaching requirement, contents of textbook, writing instruction, questions which should be paid attention to during instruction, literacy basic skills, and basic knowledge instruction requirements, etc By clicking the other button ("contents of unit") on the special library function panel, the user can get into the interface with "unit course options". The unit options comprises courses within the unit, target requirements, test for this unit, and extracurricular activities recommended.

The course option consists of "lesson preparation guidance", "collection of data", "teaching method prompt", "teaching notes samples", "intensive research", "feedback and summary". In concrete, "lesson preparation guidance" comprises twelve items: a) teaching goal requirements; b) key and difficult points; c) introduction of the author; d) background of the writing; e) key words; f) grammar and rhetoric; g) paragraph comments; h) thesis; i) characteristics of writing; j) relevant knowledge; k) exercises; l) multimedia selection guidance. By clicking the mouse the user can select one item to see its detailed contents. The "collection of data" unit provides information about the authors, background of the day, word explanation, grammar and rhetoric, paragraph structure, relevant knowledge, exercises and tests, and multimedia data. Using the "intensive research" and "feedback and summary" unit the teacher can enhance understanding of knowledge, sum up teaching experience and raise vocational proficiency, cultivate the ability to do educational research (the user's guides, 1996).

For the convenience of the user, the CALPS provides several assistant functions, including giving comments, defining bookmark, index, page down/up, enlarge/reduce font size, changing color and printing. So the teacher who has experience using Windows applications can master the CALPS quickly.

Assessment and User Feedback

The CALPS emphasizes the teacher's leading role in the teaching and learning process and lays stress on bringing the initiative and creativity of teachers into full play. Its contents closely adhere to the syllabus and give prominence to the key and difficult points of teaching. Providing full support for the whole process of teacher's teaching activity, it is helpful to the teacher in producing effective teaching notes, broadening one's view of teaching, and forming his or her own teaching ideas, to achieve the teaching goal at the end.

To install the CALPS, the computer hardware should meet the following demands (the user's guides, 1996): PC386/40 (486/66 or the above be recommended); 4MB 0(8MB or the above be recommended) memory; double speed CD-ROM driver; 16-bit sound board; hard disk 5MB free.

These requirements are not very high. But the fact is that there are a considerable number of computers in schools in China that can not meet the demands, especially the demands for CD-ROM driver and soundboard.

Some researchers (Rothan, Clerc, & Simonnet, 1988) pointed out that there remains a gap between the few teachers who use educational or professional software and sometimes even write their own programs, and the wavering majority who still feel uneasy at the idea of appropriating new technological tools. Training teachers to use computers in their classroom is a difficult problem for schools. Teaching with a computer is a skill. For teachers to develop skill, there must be opportunities for practice, both guided and independent (Gardner et al., 1988). It is also argued that one step toward making teachers feel comfortable with the computer as a teaching tool is to assist them in learning to use it as a personal tool. (Langhorne et al., 1989). A noticeable characteristic of the CALPS is simplicity of operation. Users can do almost everything only by clicking the mouse button. This conforms to the character of the user, i.e. the teacher. Teachers who have Windows operation experience need no special instruction to use it. The simplicity is also an advantage for those teachers who have no experience in computer usage. The teachers can acquire experience while using CALPS. Because they have had classroom experience, which can help them to make judgements about the educational desirability of IT usage, they can produce effective pedagogical sequences using the computer in their subject areas (Knupfer, 1993). It is obvious that the provision of in-service teacher education is often more expensive and much more difficult than pre-service owing to the fact that, in addition to the resource problems shared with the pre-service sector, high substitution costs may be incurred if teachers have to be relieved from normal teaching duties for the duration of courses (Gardner, Fulton, & Megarity, 1988). The CALPS is so easy to use that it can even be mastered by self-teaching. This can save much time and money.

Considering the contents provided by the CALPS, we could find that the data are abundant, plentiful, and convenient to use. Using the CALPS, a teacher does not need to

loop up other materials for data. This can save a lot of time and effort. Taking advantage of multimedia, the CALPS also provides text recitation with video, giving a vivid presentation of the text[see figure 3].

Just as everything has two sides, the simplicity of operation appears to be monotonous. The whole CALPS behaves like a database. With respect to the slowness when it runs on computers such as PC80386, and considering the fact that there are teachers who prefer to write notes or make plans on paper rather than 'think on the screen' (using the computer as a word processor), such a large, slow data base is not comfortable to use.

Conclusions

Advanced information technology needs to be embedded in the whole of a student's experience in teacher education to enable them to make confident personal use of a range of IT devices and key applications. In-service teacher education should be appointed the task of giving the teachers experience in IT usage. The aim is to enable teachers to produce pedagogical sequences using IT in different subject areas. Considering the cost of in-service teacher education, some computer programs with self-taught characteristics are preferred in China. Specifically through the use of the CALPS we can draw the following conclusions:

Information technology, especially computer technology can benefit the teacher's classroom teaching preparation activities to a considerable degree, with limitations set by several factors such as: a) the user's (i.e. the teacher's) psychological acceptance to and his or her previous experience with the IT, b) the relevance of the IT in solving specific problem, c) the cost and accessibility of the IT.

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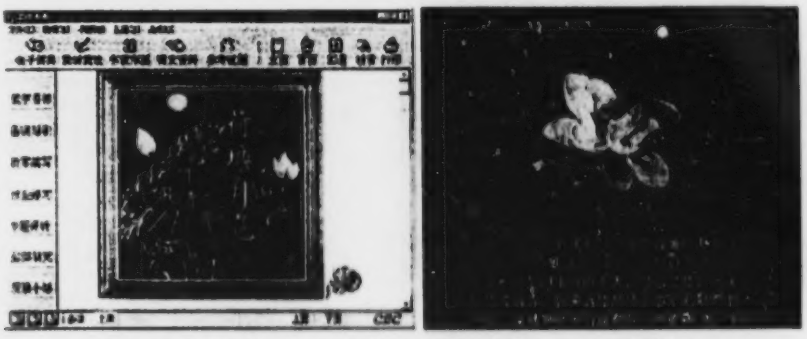

Figure 3. the text recitation with video presentation

Exploring Probability with Preservice Teachers Using Dominoes, Dice, and Technology

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As part of their mathematics education methods courses, preservice teachers need to experience effective mathematics instruction. This instruction needs to address mathematical understandings of concepts, a variety of instructional methods, and how to use manipulatives and technology to facilitate mathematical learning. The use of dominoes, dice, and a computer-designed program can provide this experience and enhance the exploration of probability concepts and pedagogy in preservice mathematics methods courses. This paper highlights an innovative and integrated probability unit used to introduce preservice elementary teachers to the use of technology to enhance the exploration of complex concepts such as randomness, probability, and graphing. The unit was originally developed by the author and Paula White, an elementary teacher whom the author co-teaches with several times a week. The unit has been used in first and third grade mathematics classrooms as well as an elementary mathematics methods course.

By utilizing concrete experiences with familiar objects (dominoes and dice), the power of random generation, and visualization of data, this unit of study enables preservice teachers to gain insight into experimental and theoretical probability through discovery activities. The connection between the physical dominoes and dice and the computer program is an essential aspect of the exploration. Students can begin their exploration with physical objects and use the computer program (designed in Oracle Media Objects) to extend their exploration and make the organization and analysis of data more efficient. This unit also creates a forum to discuss pedagogical issues of implementing a unit which:

- spans objectives across several mathematical content strands (i.e., probability, statistics, computation, estimation, patterns, number sense),
- addresses the National Council of Teachers of Mathematics (1989) four broad goals of problem solving, communication, reasoning, and connections, and
- incorporates effective use of technology.

For example, the exploration begins with each student randomly picking a domino from a double-six set (without the pieces that have a blank side). Each student should have a different domino (21 possibilities). If there are more than 21 students in the class, some students can share the same domino identity. For this purpose is the same as since they are just a rotation of one another. The domino set will only contain one of the pair (2,1).

Students become familiar with their domino identity and are oriented to the computer program by a demonstration on how to use the "domino maker" (see Figure 1) to pick a specific combination of dice and make a matching domino or to randomly roll a pair of dice that creates a corresponding domino. The "flip" feature can be used to show students how their domino appears in reverse order. Students who have a double ( ) notice that their domino looks identical when rotated but that all other dominoes look different when rotated. This leads to a discussion that students with "double" dominoes can only make their domino one way while all other students have two ways to make their domino.

The exploration continues with students physically rolling two dice in the classroom until they roll the combination of numbers that represent their domino identity. This quickly becomes a tedious and time-consuming task. Students are also not able to keep a visual representation of each number combination in front of them. This level of abstraction can be difficult for students.

However, using the computer-designed program allows the students to see the dominoes that correspond to each roll of the dice and provides a work space for the students to sort the dominoes by characteristics chosen by the user (see Figure 1). The students can randomly generate combinations in the program until their domino identity appears. The counter within the program automatically keeps track of the number of dominoes created so that the students can quickly analyze the data. After several experiments,

students will notice the pattern that "doubles" take longer to appear during a random generation of two dice.

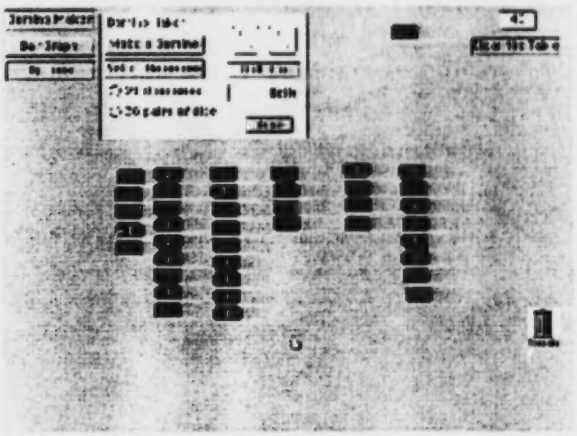

Figure 1: Example of sorting the dominoes by the first side

The students can also sort the dominoes according to the sum of the two numbers in the combination. As they do this, they get practice with their basic addition facts and soon realize that the sums range from 2 to 12 and that many sums have different number combinations that total the same amount (i.e., the sum of 6 can be made with the pairs 1,5 5,1 2,4 4,2 and 3,3, where 1,5 is a distinctly different from 5,1).

By using the computer program, students can sort the dominoes according to sums in such a way that actually builds a visual pictograph that leads to analysis of the distribution. The pictograph shown in Figure 2 shows the results of 75 rolls of dice. The corresponding dominoes were then sorted by their sum in the columns of the bar graph. Organizing the data this way leads nicely into a discussion of which sum is more likely to appear and why. Thus, experimental and theoretical probability can be discussed in a concrete way for students to understand! Repeat experiments will allow students to compare their results and make generalizations.

The powerful interplay between real objects and the computer representation of those objects provides a wonderful scenario to allow both preservice teachers and students to experience probability issues in a meaningful exploration. Preservice teachers are able to learn probabilistic concepts, different methods of instruction, and how to use manipulatives and technology as tools for teaching and learning.

At the Curry Center for Technology and Teacher Education, our goal is to educate preservice and inservice teachers on effective and appropriate uses of technology in all curriculum areas. The probability unit is an example of how technology enhances students' experiences with concepts that would be too time-consuming to explore with paper and pencil. This probability exploration represents only one of many projects being developed for this purpose. For more information on the computer program or the probability unit, please contact the author.

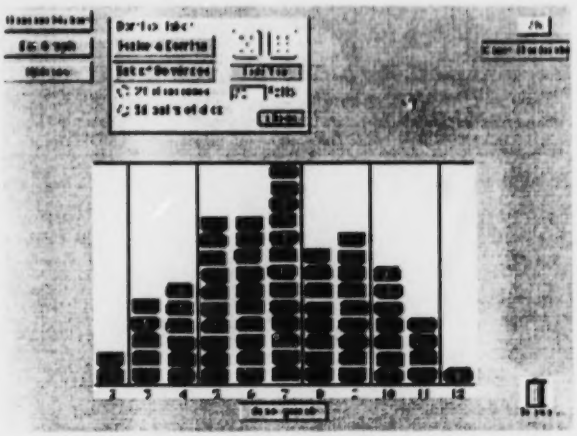

Figure 2: Sorting the dominoes by sum and creating a pictograph of the distribution

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Using the Stages of Concern Questionnaire as an Ancillary Tool to Evaluate the Effectiveness of the TEAM Approach

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This paper focuses on alternative evaluation procedures to measure the effectiveness of one of the components of the Technology in Education Adoption Model (TEAM), the computer module of EDT 343 Media and Technology For Teaching, at Miami University and Partners in Learning, a successful Ohio SchoolNet Prototype in Oxford, Ohio. In addition to standard course/workshop evaluation forms, Stages of Concern Questionnaire (SoCQ) data have been systematically collected since the inception of TEAM which indicate the approach used to teach pre- and inservice teachers is also effective in reducing their Stage 2 Personal concerns. Since Stage 2 Personal concerns are a source of teacher resistance to the adoption of education technology, it is critical that those concerns be significantly lowered during pre- and inservice professional development. In addition, 343 students consistently show gains in Stage 4 Consequence concerns and Stage 5 Collaboration concerns which indicate that that they are beginning to focus more on effective uses of technology and how technology will impact their students and less on the actual mechanics of using technology.

These are desirable outcomes from a TEAM perspective because they indicate that the technology is becoming more "invisible" for pre- and inservice teachers. In other words, pre- and inservice teachers begin to focus more on teaching with technology and less on how to use it, an indication that they have adopted education technology. Combined with consistently high student ratings of the EDT 343 computer module and Partners in Learning "playshops," the SoCQ data suggest that an authentic approach to learning technology is effective for both pre- and inservice teachers. Moreover, in K-12 contexts, the concerns identified by the SoCQ can also be found in the different stages of teachers' instructional evolution as identified by Apple Classroom of Tomorrow (ACOT) research (Sandholtz, Ringstaff, & Dwyer, 1997). Consequently, SoCQ data can be used to help identify where teachers currently fall within an instructional evolution continuum and help planners to create unique professional development opportunities that meet the concerns of the participants and provide them with methodologies appropriate for their particular stage of instructional evolution. With appropriate and effective professional development opportunities, teachers are more likely to use and integrate education technology into their respective courses of study.

Background and Context of TEAM

In the state of Ohio, two state technology initiatives, SchoolNet and SchoolNet Plus, are being advanced. The goal of SchoolNet is to hardwire every classroom K-12 for network access while the goal of SchoolNet Plus is to provide one computer workstation for every five students in grades K-4. Together both initiatives represent a $500,000,000 commitment by the state to infuse technology into K-12 education. Moreover, new state licensure standards that take effect in 1998 require that each teacher candidate demonstrate an ability to integrate technology into curriculum and instruction. Combined, these events provided the context and rationale that led to the development of TEAM at the School of Education and Allied Professions, Miami University, Oxford, Ohio.

TEAM Goal, Theory, and Empirical Foundations

The goal of TEAM is straightforward: to systematically provide multiple opportunities for undergraduates to use and integrate technology into curriculum and instruction so that as inservice teachers they will: (1) be more likely to adopt education technology; (2) be prepared to use SchoolNet/SchoolNet Plus resources as powerful tools to support and enhance teaching and learning; and (3) meet new state licensure requirements.

The theoretical constructs of TEAM are derived, in part, from the model of instructional evolution developed from ten years of research in the Apple Classroom of Tomorrow (ACOT) project (Sandholtz et al.,1997) as well as the Concerns-Based Adoption Model (CBAM) developed by Gene Hall and associates (Hall, Wallace, & Dossett, 1973). The ACOT model provides an empirical framework in which to discuss the process of technology adoption whereas CBAM's Stages of Concern Questionnaire (SoCQ) provides a statistically valid and reliable instrument to measure pre- and inservice teachers' concerns about technology throughout the adoption process. Used together, the SoCQ and the ACOT model help document the effectiveness of TEAM by providing both quantitative and qualitative data.

ACOT's Model of Instructional Evolution

For more than a decade, the ACOT project studied the effects of technology on teaching and learning. In the process, researchers developed a model of instructional evolution through which teachers progress as they adopt and integrate technology into the curriculum: (1) Entry: Teachers focus on technical issues, learn how to use the technology, become greatly concerned about time, and face typical first-year teacher problems, e.g., discipline, resource management, and personal frustration; (2) Adoption: Teachers show more concern about how technology is going to be integrated into daily instruction; (3) Adaptation: Technology becomes thoroughly integrated into traditional classroom practice and student productivity emerges as a major theme; (4) Appropriation: This is more a personal milestone and a turning point for teachers in which they come to understand technology and use it effortlessly to accomplish real work (invisible technology); and (5) Invention: Teachers experiment with new instructional practices and explore new ways to interact with their students and other teachers. Teachers also begin to question old practices and speculate about the causes for change in their students' work (Sandholtz et al., 1997).

Overview of CBAM

The Concerns-Based Adoption Model (CBAM) was developed by Gene Hall and associates (Hall et al., 1973) and posits that change is a process, not an event, and understanding the point of view of the participants in the change process is critical (Hall & Hord, 1987).

As a result, CBAM identified four clusters of concerns through which school personnel progress related to the change process. These concerns are: (1) Unrelated concerns, those which have nothing at all to do with the innovation under scrutiny; (2) Self concerns, those which deal directly with the person's perceived ability to handle the innovation; (3) Task concerns, those which relate to the actual use of the innovation and indicate that the decision to adopt has been made; and (4) Impact concerns, those which go beyond usage concerns and focus on the effect of the innovation on others (Hall, George, & Rutherford, 1979).

From this model, the SoCQ was developed which contains seven different Stages of Concern and addresses how teachers or others perceive an innovation and how they feel about it . Using the Stages of Concern, Hall and associates concluded that it is possible to predict the most likely concerns profile (Figure 1) for a teacher about to embark on a change effort.

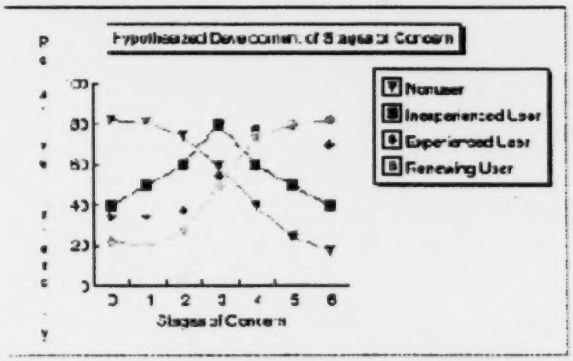

Figure 1. Hypothetical Teacher's Concerns Profile

Source: Hall, G. E. & Hord, S. M. (1987). Change in schools: Facilitating the process. Albany: State University of New York Press. (p. 62)

For example, if no unusual information is known about the innovation or the teacher, then the prospective users of the innovation are assumed to have typical "non-user" concerns. In other words, their concerns will be more intense at the Stage 0 Awareness, Stage 1 Informational, and Stage 2 Personal levels and relatively less intense on the Stage 4 Consequence, Stage 5 Collaboration, and Stage 6 Refocusing levels. In addition, if Stage 2 Personal concerns are not resolved but are further heightened, then the entire evolution of the change process and the potential for the arousal of higher stages of concern are endangered (Hall & Hord, 1987).

TEAM Description

While TEAM is operationalized in four different courses offered by the Department of Teacher Education (EDT) at Miami University, only one course, the computer module of EDT 343 Media and Technology For Teaching, is described here. In this module, students are first exposed to education technology over a seven week period. The main instructional objective is to provide students with authentic contexts in which they learn how to integrate technology into the curriculum and to use technology to enhance student learning. Toward that end, students are divided into interdisciplinary/intergrade teams and are required to plan, peer teach, and evaluate a problem- or

project-based unit (or part of a unit) of instruction that uses technology to support and enhance learning. During the first 4 1/2 weeks students are given "need to know" instruction in word processing, database, network and web conferencing resources, an electronic gradebook, and multimedia production tools (digital photography, audio and video digitization, web-based multimedia resources, and scanning). Students are also introduced to constructivist learning and instructional design models and asked to use the above technologies within these approaches to teaching and learning. During the last 2 1/2 weeks student teams are each given 300 minutes of class time to peer teach their lessons and must demonstrate their ability to use the technologies as both productivity and learning tools to accomplish their stated instructional objectives. All lessons are videotaped and students are asked to analyze their performance after they have completed their teaching obligations. This approach allows students to learn necessary teaching and technology skills within authentic contexts, much like inservice teachers do. For example, peer teachers use ClarisWorks word processor to create their lesson plans and instructional handouts and create databases to use as classroom management and instructional tools. Internet, web, and multimedia resources are integrated into ClarisWorks slide shows that peer students create and present as part of their assigned tasks during peer teaching. Peer teachers use an electronic gradebook to record and report grades and attendance data to their students. All students are also required to use Internet e-mail to "ask an expert" about teaching content and to use Conferencing on the Web (COW) to ask SchoolNet teachers about teaching strategies related to using technology. To offer prospective employers a glimpse of their teaching with technology skills, student teams digitize video of their teaching which is then published to the web along with other relevant data about the lesson and themselves. Using this approach offers two main advantages: (1) students learn how to properly use technology within authentic educational contexts; and (2) skill development is embedded in these activities rather than through a direct instructional approach. Evidence of the effectiveness of this approach to learning technology comes from: (1) pre/post Stages of Concern Questionnaire (SoCQ) data; (2) COW entries and class discussions that pertain to the adoption of technology; and (3) course evaluation data.

This same approach was also successfully used during technology "playshops" which were conducted during the summers of 1996 and 1997 at Talawanda City Schools, Oxford, Ohio, a successful Ohio SchoolNet Prototype, in which teachers were trained to use SchoolNet and other technology resources. During the first Playshop (1996), whole group instruction was used only once at the beginning of the two week period to help participants develop a "Big Picture" about using SchoolNet and consisted of a demonstration on how a typical teacher might use SchoolNet resources in his or her classroom. Teachers then went to their respective classrooms and used the district's telecommunications server and network to participate in simulations where they defined potential uses of networks and technology and began to develop technology-based resources for their respective courses for the coming school year. This same approach was used the following summer only it was expanded to meet building-level needs by conducting "just-in-time" mini-workshops based on participants' stated needs, both for their classrooms and for their buildings. Consequently, teachers not only learned how to use SchoolNet resources, but they also began to learn when and why to use these resources. In other words, learning to use technology was done within the context of their specific jobs, thus giving participants a better feel for how they might begin to use technology. Evidence of the success of this instructional approach came from: (1) pre/post SoCQ data (which was also used to help develop the learning activities for the playshops); (2) positive feedback from playshop evaluations; (3) increasingly positive messages posted on the telecommunications server as the playshops progressed; and (4) the fact that many participants stayed and worked long after they were officially dismissed each day.

Discussion

To help evaluate the effectiveness of both the computer module component of TEAM and the playshops, multiple indicators were and are used in addition to standard course/workshop evaluation data. These indicators include students' reflections posted on COW and pre- and post-surveys of the SoCQ. Students take the pre-SoCQ via the web during the first day of the computer module which gives them and the instructor some immediate baseline data about their concerns dealing with education technology. At the end of the module, students take an identical online post-SoCQ which gives them a chance see how their concerns about education technology have changed over the seven week period. The pre/post data are then analyzed to look for significant differences within individual stages and to create composite class concerns profiles. This procedure was also used during the previously discussed playshops.

As teams begin to teach in the EDT 343 computer module, a predictable pattern emerges. The first two teaching teams are terribly concerned about using technology in their lessons and tend to neglect good instructional practices such as informing learners of the lesson's objective or having learners recall needed prerequisite knowledge and skills. Questions that their peer students ask them are typically "how to" kinds of questions and usually both peer teachers and students are more concerned about using the technology rather than completing their lessons or assignments. However, since all students get their skill development through repetition and practice within the context of

the lessons peer taught, by the time the last two teams teach, questions begin to shift from technology-related issues to teaching and learning issues. Curiously, students consistently report that not enough time is given in class for skill development, yet most students agree that by the time the last team has taught, they are no longer concerned about how to use the technology and are more concerned with how the technology will impact their students. The SoCQ data typically confirms this phenomenon by indicating that many students begin to lose their Stage 2 Personal concerns about teaching with technology and increase their Stage 4 Consequence concerns, an indication that students are beginning to focus more on the impact of technology rather than the technology itself. However, there typically isn't much change in Stage 3 Management concerns which deal with the students' concerns about being able to use technology. Perhaps this can be explained by the fact that most students start with a "non-user" concerns profile with its attendant relatively low Stage 3 concerns and by the time they take the post-SoCQ, they have mastered using the technology and are simply not very concerned about this aspect of it. To test this hypothesis, the SoCQ would have to be given right before student teams began their teaching when their "how to" concerns are at a peak.

Students' progress is also consistent with the ACOT model of instructional evolution developed by Sandholtz et al. (1997) because students typically demonstrate Entry and Adoption level concerns about focusing on technology, learning to use it, and integrating technology into their lessons. Moreover, students are usually very concerned about the time it takes to teach with technology and most display personal frustration with the process, all typical Entry level concerns of teachers. As more teams peer teach, however, these concerns diminish and both peer teachers and students generally begin to become more productive in using the technology (Adaptation) and use it effortlessly to accomplish real work (Appropriation). Because Invention level behaviors are embedded in the course requirements and because there is simply not enough time for students to really display authentic behaviors typical of this stage, it is difficult to determine whether any of them ever reach this level. After all, seven weeks just is not long enough to really change students' beliefs about teaching and learning although many students show gains in Stage 4 Consequence concerns and Stage 6 Refocusing concerns which indicate that they are thinking about how technology impacts students and different ways it can be used other than what was introduced to them in the computer module.

Quantitative and qualitative results from the computer module evaluations are also consistently positive and students, for the most part, indicate that they plan to use technology when they become inservice teachers. However, there are consistent complaints about not having enough time to learn all the technologies introduced in the computer module nor do students feel comfortable about their ability to perform basic troubleshooting functions when the technology does not work. This indicates that while students significantly reduce their high Stage 2 Personal concerns, those concerns still persist at a relatively high level.

In general, however, these are desirable outcomes from a TEAM perspective because the Concerns-Based Adoption Model posits that relatively high Stage 2 Personal concerns can act as a significant barrier that prevents teachers from adopting and using an innovation. Moreover, the increasing Stage 4 Consequence concerns indicate that 343 students are becoming less concerned about their ability to use the technology within teaching and learning contexts and more concerned about how the technology will impact their students, an indication that students have made the decision to adopt and use technology in their professional careers

SoCQ data can also be used to measure the progress of inservice teachers related to technology adoption. As teachers begin to adopt and use technology, their concerns need to shift from Personal concerns to Impact concerns to reduce potential resistance to the adoption of education technology. SoCQ data can therefore be used to ensure that this phenomenon happens by identifying the current concerns of teachers and helping planners develop relevant professional development activities which address these concerns. While this obviously takes more planning and preparation, school leaders will find that overall satisfaction with professional development activities increases because the concerns of all participants are being addressed. This also helps explain why some teachers find particular professional development opportunities a waste of time while others find the same opportunity richly rewarding.

Conclusion

TEAM offers a systematic approach to preservice teacher education in the area of technology adoption and utilizes the power of network technologies to connect preservice teachers with inservice teachers, an approach endorsed by the Office of Technology Assessment (1995). The model recognizes the importance of learning technology within the context of authentic educational experiences and attempts, through a series of courses, to provide students with multiple opportunities to teach with technology instead of simply teaching them how to use technology. This goes well beyond the standard practice of technology training found in most teacher education programs today and can serve as a useful model for other interested faculty. Moreover, TEAM uses an integrative approach to technology adoption. There is no "technology ghetto" supported in this model and empirical data suggest TEAM is effective in accomplishing its objective of encouraging preservice teachers to adopt technology in their entry-year and beyond. TEAM also has a web presence at http//:www2.eap.muohio.edu/TEAM/ which interested parties

can access to learn more about this approach to education technology adoption.

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Examples of Best Practice in the Use and Integration of Educational Technologies for K-12 Teacher Preparation

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During 1996, a team of three researchers from the University of Northern Colorado were selected to conduct a study for the Research and Information Committee of the American Association of Colleges for Teacher Education (AACTE). The focus of that research effort was to investigate the adequacy of the technological infrastructure for information technologies (e-mail, Internet, distance education) at individual Schools, Colleges, Departments of Education (SCDEs) as well as across a large sample of SCDEs. Results clearly indicated that: (a) an overwhelming majority of respondent SCDEs had adequate infrastructure to support the use of information technologies and (b) over 95 % of the respondent SCDEs had faculty and students who were using information technologies (Persichitte, Tharp, & Caffarella, in press; Tharp, in press). While these results were satisfying for their potential impact on the preparation of preservice teachers, the researchers were further interested in the actual uses (both quantitative and qualitative) of multiple educational technologies. Thus, the same researchers found themselves engaged in the study which is the topic of this paper.

Many recent reports and research projects have identified a gap in the readiness of novice teachers to effectively utilize educational technologies within their classrooms for curricular or instructional purposes (e.g., National Commission on Teaching and America's Future, 1996; Office of Technology Assessment, 1995; American Association of Colleges for Teacher Education, 1997; Awbrey, 1996). The purpose of the case study in integration of educational technologies is two-fold. First, to document and analyze factors, both positive and negative, associated with the integrated use of educational technologies within SCDEs. Secondly, to develop configurations (rich descriptions) of best practices of technology use and integration to serve as models for preservice teacher program revision and revitalization. Site visits were conducted at the University of Arkansas at Fayetteville, Graceland College in Iowa, and the University of Virginia Curry School of Education. [At the time of this printing, site visits were still in progress. Preliminary results of the data analysis will be presented at the SITE 98 Conference.]

Research Questions

The following research questions were used to guide the study and to develop the interview protocols.

RQ1: What are the characteristics of preservice teacher faculty, students, curricula, and programs which would currently be considered examples of "best practice" in the use and integration of educational technologies for the preparation of K-12 teachers?

RQ1a: How have these best practices evolved?

RQ1b: What documentation and/or artifacts lend support to the effectiveness of these best practices?

RQ1c: What are the "secrets" and the cautions which should be shared with other SCDEs as we strive for improved preservice teacher preparation in the use and integration of educational technologies?

RQ2: What are the resultant impacts of these best practices on preservice teacher performance during: (a) field experiences; and (b) student teaching?

RQ2a: How has the use and integration of educational technologies within the preservice teacher preparation program(s) affected the SCDE related to planning for, maintenance of, and meeting user demand with existing infrastructure?

RQ2b: How has the use and integration of educational technologies within the preservice teacher preparation program(s) affected the preservice teacher faculty and curriculum?

Research Design

This study is a qualitative, case study analysis of three AACTE member SCDEs. The three teacher preparation institutions were selected by the Research and Information Committee of AACTE. Specifically, the research team (Persichitte, Caffarella, & Tharp) employed an empirical phenomenological observation method; gathering perceptual descriptions from people who are involved in the actual experience of preservice teacher education in combination

with the integration of educational technologies. All data collected were documented, transcribed as necessary, and reviewed by each institution prior to any presentation or publication of results. Data were triangulated for each institution with observations, interviews, and concerns survey data (Hall, Dossett, & Wallace, 1973).

During the site visits, we observed: (a) SCDE classrooms, (b) SCDE computer/media lab facilities, (c) two or three methods classes, and (d) other general access to campus information technologies. At each site, we interviewed: (a) three to five teacher preparation faculty, (b) the lead administrator in the professional education unit, (c) three to five teacher education students (variety preferred; e.g., differing stages of their program, non-traditional student, elementary/secondary), (d) two to four teacher education students who were student teaching, and (e) two recent graduates of the SCDE who are now classroom teachers. The third set of data which we collected was concerns survey data. We asked that all those who consented to interviews complete the survey. The paper survey required about thirty minutes to complete. These surveys were sent out in advance of our site visit. In general, we informed the host institutions that we were interested in visiting with faculty and students who have demonstrated high interest in further integration of educational technologies within their professional endeavors or who have become role models among their peers for continued technology integration efforts.

Data Analysis

Data other than the concerns survey data will be coded for electronic analysis using QSR NUD(IST, a software application designed for the manipulation and analysis of ill-structured data. Observation data will be used to develop an in-depth description of the degree of integration of educational technologies (both in amount and type) and the naturalistic/environmental variables which were most salient within each institution. Cumulative analyses will focus on: (a) providing suggestions for strategies and interventions ("best practices") to facilitate the further integration of educational technologies within preservice teacher preparation, and (b) presenting one or more implementation models for SCDEs characterized by similar environmental variables. The interrelated elements of the systems under consideration in this study are complex and must be viewed with attention to the dynamic nature of educational technologies and the contemporary external influences on teacher preparation. The phenomenological approach combined with the site visit will allow the researchers to maintain a systems perspective for this study.

Summary

This research effort is an attempt to look beyond issues of access to technology; to instead, focus on identification of exemplary uses of educational technologies within SCDEs. As trained educational technologists, we agree with Hall and Hord (1987) when they write, "For schools to improve, teachers must change. For teachers to change, there must be appropriate and promising practices and procedures (i.e., innovations) that they develop or adopt, and, when necessary, adapt. Student achievement and other desired outcomes are enhanced when teachers improve their practices and use more effective instructional resources" (p. 5). Effective and efficient utilization and integration of educational technologies will not occur without substantial investment by both the individual classroom teacher and the SCDEs which prepare them. In a description of the Apple Classrooms of Tomorrow (ACOT) project, Sandholtz, Ringstaff, and Dwyer (1997) say that, "[T]echnology by itself was not the silver bullet. In fact, it added another layer of complexity, a whole new set of things for already overworked and stressed teachers to learn and manage...Its [technology] use in instruction and learning changed as teachers themselves changed" (p. 36). Hopefully, the results of this research project will provide a foundation upon which other SCDEs can build as more external communities move to hold SCDEs ultimately accountable for the improved education of the children in our public schools.

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A Multimedia Demonstration of the Urban Education Initiative for Preservice Teachers

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One of the major challenges facing the educational profession during the 1990s is the improvement of education in urban areas. Currently, approximately 39% of Latino American children and 46% of African American children live in poverty (National Center for education Statistics, 1994). With large concentrations of minority children in urban areas, providing quality education to students in urban areas during the 1990s and beyond is an especially challenging proposition. Nevertheless, urban school districts have more difficulties in recruiting teachers than do other districts. According to the findings of Choy, Henke, Alt, & Medrich (1993), districts having 20% or greater minority enrollment found it harder to find qualified teachers. For Inner city schools, teacher shortages are three times higher than for other districts (Darling-Hammond, 1990).

In spite of the shortage of qualified teachers in urban areas and eagerness to enter the teaching profession on the part of the preservice teachers, education graduates so often are reluctant to seek careers in urban areas because of real and imagined fears. The Urban Education Initiative developed at Shippensburg University is one of the programs to address these concerns.

The Urban Education Initiative was a partnership program between Shippensburg University and the York City School District of Pennsylvania. The purpose of the program was to have teacher education majors become more sensitive to the special needs of all students and to become more aware of the unique educational challenges and opportunities that presented themselves in many urban schools.

Forty nine teacher education seniors participated in the program in the spring of 1995. Apart from spending 4 days in 7 elementary schools in York, they also visited William Penn High School, the Crispus Attucks Community Center, the Spanish American Center, the Health Education Center, and attended multiple professional development programs conducted by the York City Personnel. It was a one-week intensive training program highly spoken of by all participants. This research was used as a partial evaluation tool to assess the effectiveness of this program.

Purpose of the Research

The purpose of the research was to assess the impact of the Urban Education Initiative on the SU students' perceptions of city schools. These perceptions of SU teacher majors were indicated by 12 variables that included their perceptions of personal safety, relation to minority children, management of classroom discipline, children's health, school supplies, personal vehicle safety, children's hygiene, teacher salary, AIDS risks, physical building conditions, relationship with colleagues, and relationship with parents.

Research Design

The design of the research was a Quasi Single Group Pre-and-Posttest. The subjects were 49 preservice teachers from the Shippensburg teacher major seniors. The instrument was a self-designed survey questionnaire that consisted of 3 parts: The first part collected the background information about these students, which included the kind of schools they attended prior to Shippensburg University and how many days they had spent in urban schools. The second part solicited their perceptions about urban schools as indicated in the above mentioned 12 variables, ant the last part asked about their general comments about the program. The 12 variables indicating their concerns about city schools were measured by a modified Likert scale consisting of Very Concerned, Concerned, Undecided, Little Concerned and Not Concerned, and a dichotomous scale was used in the last variable to ask about their willingness to accept a teaching position in an urban setting. The pre survey was conducted a week before they went to York, and the post survey was completed 4 days after they returned to the University.

Results

Forty five usable questionnaires were collected from both surveys, achieving a return rate of 92%. Among the participants in the research, only one person who had spent

above 40 days in an urban school prior to Shippensburg University. 35 people had fewer than 5 days, and over half of the group never visited an urban school.

The collected data was processed by the SPSS statistic program. Descriptive and inferential statistic procedures were used to analyze the data. Paired t-tests were calculated to find the statistically significant changes of their perceptions as indicated by each variable before and after they participated in the program. Of the 12 variables computed, 5 demonstrated a statistical significance between the pre and post surveys at .001 level, and 1 variable was significant at .05 level. The means and standard deviations of the 6 pairs of variables that were tested significant are reported in the Table 1.

Among the differences found, the change of perceptions on Personal Safety in an urban school headed the list with $t(44) = 6.44$, $p < .001$. Figure 1 illustrates this change of perceptions on Personal Safety:

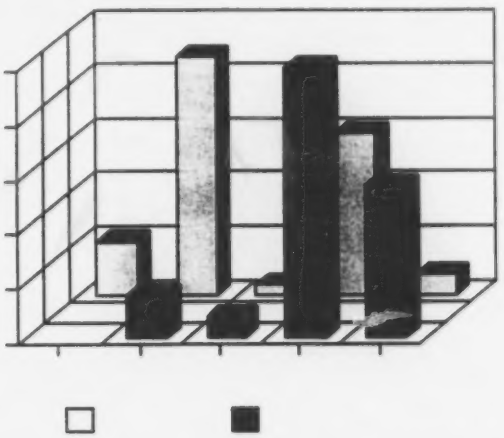

Figure 1. Students' Change of Perceptions on Personal Safety (n = 45)

This significant change of perceptions on personal safety was followed by their change of perceptions on Relation to Minority Students, $t(44) = 4.64$, $p<.001$; Safety of Personal Vehicles, $t(44) = 4.51$, $p< .001$; and Management of Classroom Discipline, $t(44) = 4.48$, $p< .001$. Figure 2 and Figure 3 illustrate the findings of the pre and post surveys on students' change of perceptions on Relation to Minority Students and Classroom Management:

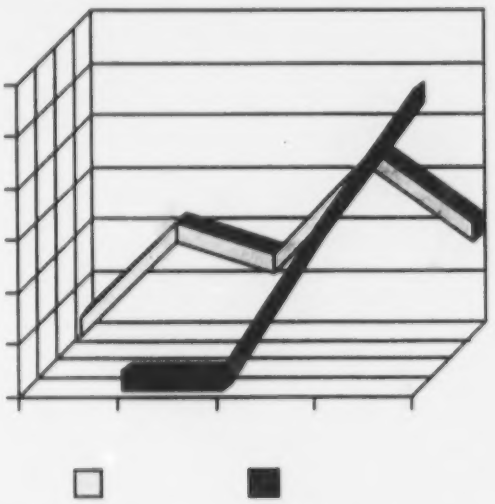

Figure 2. Students' Change of Perceptions on Relation to Minority Children (n=45)

In the above figures, the data in the post survey wiped out the first category (Very Concerned) in all three variables, and demonstrated a drastic change of their perceptions of personal safety, relationship to students, and management of classroom discipline in an urban educational setting. This radical change of perceptions was also reflected in students' perceptions of personal vehicle safety in urban areas.

Table 1. The Means and Standard Deviations of the Six Significant Pairs of Variables

	Pretest			Posttest		
Variables	*M*	*SD*	*n*	*M*	*SD*	*n*
Personal Safety	2.71	1.18	45	4.09	.85	45
C. Management	2.82	1.13	45	3.78	.97	45
Teacher Salary	3.07	1.07	45	3.80	1.06	45
Relate to Children	3.56	1.14	45	4.56	.66	45
Colleague	4.16	.85	45	4.56	.69	45
Car Safety	3.24	1.30	45	4.18	.75	45

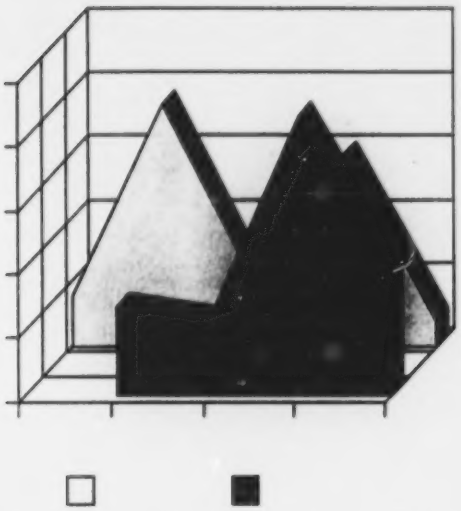

Figure 3. Students' Change of Perceptions on Classroom Management (n=45)

Other significant differences were found on Salary, $t(44) = 3.63$, $p < .001$ and Colleague Relationship, $t(44) = 2.25$, $p < .05$. No statistically significant difference was indicated in the student perceptions regarding children's health conditions, school supplies, children's hygiene, AIDS risks, physical facilities, and relationship with parents.

For the sake of clarity and brevity, the writers combined the "Very Concerned" and "Concerned" answers into a large group and compared its size and intensity in the pre and post tests. Figure 4 illustrates a significant reduction of students' concerns with working in an urban school after they participated in the program.

Summary and Discussions

The findings from the pre and post surveys were quite interesting. Data from the pre survey indicated that the students involved in the Urban Education Initiative had little experience in urban schools. Most of them had never been in an urban classroom prior to the program. Moreover, the pre survey data indicated that many of the university students involved had a number of significant concerns that could possibly discourage them from seeking employment in urban schools. Post survey data indicated their concerns were significantly abated in 6 of the 12 variables that measured levels of concern. This Urban Education Initiative had exerted a great impact on their perceptions of personal safety, relationship with students, managing an urban classroom, vehicle safety, salary scale and relationship with colleagues in an urban educational setting.

Though the program also had some positive impact on student perceptions of school facilities and AIDS risks, its influence was not statistically significant. It had practically no impact on their perceptions of relationship with parents. This phenomenon might partly be attributed to the fact that, during the program week, these students had no chance to work with urban parents, and how to relate to and work with urban parents will make a very interesting topic for our future research.

Only one variable (school supplies) showed a slight negative direction. 40% of the participants was concerned about the school supplies in the pre survey, and this percentage of concern increased to 42% in the post survey. This negative increase was possibly influenced by what they saw in classrooms and a few stories they heard about school supplies during the week, and it was not statistically significant.

Due to the fact that the sample was relatively small and not drawn randomly from a larger population, in spite of the significant differences that existed in the perceptions of the preservice teachers between the pre and post tests, the result of the research was not generalizable to more students. Nevertheless, the findings were very significant to the students who participated in the program and to the Teacher Education Program of Shippensburg University. One of the most encouraging aspects of the post survey data was the comments of participants. All of them indicated that they thought the project was very helpful and should be continued. 28 students made enthusiastic entries in the last open-ended item. Their comments and remarks offered an overwhelming endorsement of the effectiveness of the program.

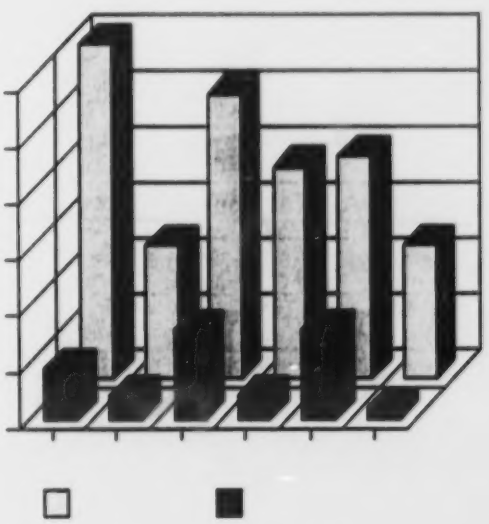

Figure 4. Reduction of Students' Concerns between Pre and Post Surveys (n = 45)

Multimedia Presentation of the Research

This demonstration was first created by using Macromedia Director 4.0, which was a movie composition program where movies were composed from elements that were either created on or imported into the Director. During the Urban Education Week, the researchers took 70 photos and kept ample notes. Based on those photos and interviews, the researchers designed the multimedia presentation by using the Paint, Cast and Score Windows of the Director. For the software conformity and convenience of the presentation at the 9th SITE Conference, they converted it into a Power Point presentation. The finished product contained 40 screens, twenty scanned pictures, 3 movie clips, 4 research figures, some music and many hypertext pages. Though some animations were lost in the conversion, many of the designing principles and major features were quite similar. Some of their suggestions are as follows:

1. Overall design of the presentation

The overall design of a multimedia presentation is critical. The designers not only have to consider what they want to present, but also what messages the audience will get from viewing the hypertext screens. Very often the audience are drawn toward the dazzling electronic bells and whistles. The designers need to spend much time at the beginning of the project selecting the most effective approaches.

2. Readability of the screen

Readability of the screen is very important, because the bulk of the information will be obtained from these screens. It can be achieved by selecting appropriate font size, content words and the number of headings. The recommended font for the opening page may be set at around 40 points with each page containing no more than 6 lines. It is unnecessary to write the detailed information on the screen. When the presenter reads the 5 to 6 essential words in a line, the readers will be able to fill in the rest of the information. For general purposes, using templets is often a convenient shortcut.

3. Import digital images

The Macromedia Director and Microsoft Power Point employ different ways to import graphs, charts, pictures, and videos, but the methods are more or less the same, namely, cut and paste, insert or import. Spending some time on the software, one will get used to them quickly. It is the creativity and depth of the project and selection of images that will take the bulk of one's time.

4. Avoid screen clutter

Because multimedia software enables the designers to use all fancy tools with great ease, it is important not to distract the readers by using too many dazzling digital images or music. Sometimes, excessive use of transitions and special effects many make your presentation too "cute." Consequently, the ultimate purpose of the presentation is compromised.

5. Logical reasoning vs. nonlinear nature of multimedia presentation

The definition of the multimedia is any combination of data, digital movies, animations, graphics, text, and sound delivered on a computer. It is a highly nonlinear environment. Therefore, the designer need to balance the logical and sequential presentation of main content pages with temptation of overwhelming effects. 6. Navigation control It is important that the presenters should designed the demonstration in a way that they can navigate the demonstration with ease and can change the length and direction of each screen at will.

Selecting and designing a multimedia presentation is a never ending learning process. In preparing this project, the researchers tried Macromedia Director, Authorware, Asymmetric ToolBook II, and finally landed on Microsoft Power Point. They might have just scratched the surface of the capacities of these multimedia software, but one thing is clear, that a multimedia environment has certainly made their presentation more effective and, therefore, made their research more accessible to more of their students and colleagues.

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We're Dancing as Fast as We Can: Technologies for a Year-Long Student Teaching Experience

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Preparing student teachers to be able to use technology effectively in today's classrooms is a critical role for teacher education institutions. Over 200,000 new teachers enter the profession each year (President's Committee of Advisors on Science and Technology, 1997), with a 50% turnover of the teaching force approximately every 15 years. Nevertheless, technology is not a major component of the teacher preparation experience in most colleges of education. The Office of Technology Assessment (OTA, 1995) found that most technology instruction in colleges of education is teaching about technology as a separate subject, not teaching with technology across the curriculum. The majority of teacher education faculty do not model technology use to accomplish objectives in the courses they teach, nor do they teach students how to use information technology for instruction. Seldom are student teachers asked to create lessons using technology (OTA, 1995). In fact, currently, just 32 of the 50 states require courses in educational technology for obtaining teaching licenses (CEO Report, 1997)

Although Illinois is one of eighteen states still not requiring technology courses for certification, the College of Education at the University of Illinois at Urbana-Champaign has been integrating technology into the student teaching experience within an innovative program for elementary education, the Year Long Program (YLP). Now in its fifth year, the technology initiative within the YLP was jump-started in 1993 by a project funded by the National Science Foundation called Teaching Teleapprenticeships. The YLP has evolved into a permanent component of the teacher education program in the College of Education and has served as a pilot for redesign of the entire student teaching program.

The one constant feature of the YLP has been adaptation to change. While, the program has gradually become institutionalized, the technology infrastructure has changed, the teaching methods have changed, and the syllabus has changed. This paper will describe this change process which has been central to the success of the program.

Overview of the Year-Long Project

The YLP is a model elementary teacher education program based on collaboration between the University faculty members and local public school teachers. It is considered unique because it integrates extensive classroom experience and methods courses within the final year of teacher preparation and asks classroom teachers to play a strong collaborative role in training, advising and evaluation of the preservice teacher. These cooperating teachers are known as the Advisors. After the first eight-week session in the Fall, the Advisors arrange at least two classroom visits and follow-up conferences with their Advisees during the second eight-week placement and during the Spring semester. Additionally, they participate in all student teaching evaluation conferences throughout the year.

The preservice teachers enrolled in the YLP participate in three separate classroom placements. During the Fall semester there are two eight-week placements of two and one half days per week in the classroom. The placements are usually within the same school, but at different grade levels. The first placement also includes a full week in the classroom as school opens. This is done so that classroom organization and beginning-of-year activities can be experienced. As the YLP preservice teachers grow in experience they are entrusted with more classroom responsibilities, take a larger role in planning, and teach more frequently and for longer periods of time.

When the preservice teachers enter the Spring semester, they are placed in another school, at yet another grade level. The Spring placement, which lasts the whole semester, is for two and a half days per week until the end of February; then the preservice teachers spend full time in the classroom and attend a weekly seminar in the evening with instructional team members.

The four integrated methods courses, all of which require class time for a semester and a quarter, follow: 1) Language and Literacy (L&L), which integrates three traditional courses, reading methods, language arts methods, and children's literature, is nine credit hours. 2) Curriculum and Instruction (C&I), which integrates general elementary methods and technology, is six credit hours. 3) Social Studies methods, which has been expanded so that further study of and experience with diversity could be given its place in teacher preparation, is four credit hours. 4) Science methods, which has a constructivist focus, is three hours. (Math methods is required prior to entering the YLP.)

Since technological literacy is viewed as an integral part of what it means to be a teacher, instructional time is provided for training in the use of technology in education, and assignments within the methods classes require use of computers and relevant peripherals and software.

YLP Students' Use of Technology in their Courses

During the year-long program our students are working intensively to experience the classroom and to gain further theoretical insight and—to the best of their ability—fuse the two; they are asked to use their computers in all of their methods courses. Generally, they must monitor email from all instructors. We have separate reflector lists for faculty, graduate assistants, and students. We fuse the three to create the general list. Instructors send assignments, require assignments, and send changes to the semester plans as a minimum.

As a part of what is called a general elementary methods course the students are asked to write three reflective journal entries weekly; monitor email communication from their instructors, supervisors, and other students; complete technology surveys of the classrooms in which they are placed and send the results to the instructor via email; write a unit of four or more lessons using the word processor and any other tools they deem necessary; browse the web for resources for the unit; browse the web for five sites of use to them as teachers and review what they have found; review multi-media software which may be used in their classroom or in the building of their units; and create an ideal third grade class. That means drawing the room using an appropriate tool, writing lessons, creating a schedule, and describing their classroom organizational strategies including building of community. At least one lesson is to incorporate the use of technology.

Finally, as part of the general methods, selected teachers speak to the students regarding their teaching. One such teacher not only showed the projects that her students had created on PowerPoint, but discussed the differences between teaching based on units and teaching based on projects. Students were able to see how second graders could use the scanner, camera, and computer to create pages and hear about the philosophy of teaching that underlies projects as a method in elementary school instruction.

Impact

On the basis of surveys of the YLP graduates of 1996 and 1997, we can say that some our graduates are highly involved with technology as a part of their professional lives. It is not possible to claim that the experiences with computers, peripherals, and software provided during the YLP are the only cause of this involvement, but we can claim partial credit for the following:

Via email, we are still in communication with 9 graduates of 1997, 3 graduates from 1996, and 1 graduate from 1994. These messages are both personal and professional communications. The graduates are located in Japan, California, Texas, some small towns, the Chicago suburbs, and the local Champaign-Urbana area. Although a very few of our gradates choose to teach in the City of Chicago, none of them are communicating with me via email. The YLP graduate who is currently teaching in Japan has sent detailed information about her experiences and has volunteered to be a resource for any of this year's class as they implement their units this spring. Others have responded several times regarding their teaching and recommendations for the further enhancement of the program.

The local email traffic is usually regarding graduate courses or involvement in the teaching and mentoring of our current YLP students. However, most recently, a 1997 graduate located in the Chicago suburbs asked for help in creating a unit in Spanish (she teaches middle-school Spanish among other things).

The survey of the 1997 grads indicated that 26 of the 40 graduates (65%) are first year teachers; an additional 5 are full-time as aides and/or subs (77.5% are then known to be in the field of education) ; 4 are in industry/business; and we have not heard from five. We hope that one or two more will pick up the survey that was mailed to their parents' homes and respond during the winter break.

In terms of the involvement of the 1997 graduates with technology as a part of their careers, the survey revealed that

- one is training to become—next year—the technology mentor for her school,
- one has successfully written a proposal to get more CDs and drives for her room,
- one has written a proposal for more technology for her room,
- one has taken the lead in getting his school wired,
- numerous graduates have commented that they are seen as technologically savvy and that older teachers seem to admire their knowledge and willingness to create instructional opportunities for chidden,
- numerous graduates have written about the hardware in their classrooms,

- some graduates have written about the infusion of technology in their teaching,
- some graduates have made recommendations regarding the technology training of future elementary and middle school teachers, and
- one graduate referenced her school's web page and then footnoted it with the warning that it was not really slick.

The graduates of our program are also complaining about the lack of modern technology in their rooms and schools. The graduates yearn for equipment that allows the use of the Internet and web. We will continue to include a small workshop on writing of proposals in our Spring semester as one of our contributions to changing our schools.

Technology Infrastructure:

It is important to situate the technology infrastructure of the College of Education within current trends in educational technology. In a May 1996 survey of schools of education, only 45% of faculty regularly use computers or TV with VCRs for interactive instruction during class periods (Zehr, 1997). Furthermore, the same study found that 53% occasionally used some electronic technology to present materials in class. Surprisingly, the report found that 58% of schools of education do not have any classrooms wired for the Internet. These data indicate that, despite our best intentions to prepare future teachers for technology-rich classrooms, teacher education institutions may not be practicing what we teach.

Yet, in programs like YLP, we have sought to overcome some of these shortcomings by looking at the cumulative technology profile of the student teaching experience. The technology profile of the YLP consists of many components, which include:

1. Mobile computing in the form of laptop computers.
2. Access to advanced computers in the College computing lab.
3. Awareness of and guidance on how they can use the computers in their placement classrooms.
4. Encouragement on the use of home computers
5. Information servers for on-line resources.
6. Coordination of University computing resources.

Central to the technology strand of the YLP is the idea of ubiquitous access to computers for communication. This was a goal of the Teaching TeleApprenticeships (TTA) project. TTA provided laptop computers (with support from Apple Computer, Inc.) to YLP and other teacher education students to facilitate e-mail communication between the student, his or her faculty advisor, and cooperating teachers. The PowerBooks are Macintosh 145 models with Microsoft Works (donated by Microsoft, Corp.), Eudora, and Netscape. They have dial-up connectivity to the students' free campus PPP access at 14.4 kbaud. In the first two years, the PowerBooks only had 2400 baud modems and 4 MB of RAM. But with advent of the Web in 1995, we added more RAM and replaced the modems. One of the practical benefits of the PowerBooks is that whenever there was a technical problem with them, the student could bring the unit to the TTA office where there were graduate students to either fix the problem or swap the unit.

Although we are using the same basic PowerBook that we started with in the Spring of 1993, their use has changed over the years. For example, since Eudora was developed at UIUC, we were free to install it on all the PowerBooks. Eudora's client architecture fit nicely with the TTA model of anytime access to e-mail. Students could stay in the familiar Macintosh operating system to check mail on their University Unix account without having to learn Unix, or having to have the continuous connection of a telnet session. In the Fall of 1995, the University went to on-line course registration, which meant that every student had to know how to use telnet to enroll in courses. At the same time, the campus computing office implemented an improved Unix e-mail application for telnet access called Pine. These two developments, on-line registration and Pine, caused a migration away from Eudora to Pine.

A parallel development at this time was the growth in networking in the placement schools, University residences, and in the College. Since Pine centrally stored all their mail in mailboxes just like Eudora AND they could access from all their contexts, the shift in student preference was based on factors not of our design.

These changes influence how the PowerBooks and other infrastructures were perceived and used by the students. The College has two computer labs that are available to the YLP students. Of course, the technology of these labs has changed in five years, from being mostly LC-class Macintoshes in 1993 to now include advanced PowerPC Macintoshes and Pentium-class Windows machines with plenty of multimedia hardware and software.

Since the capabilities of the technology had changed, so did the contexts for using it. In the first two years, the PowerBook was the infrastructure. It had everything the students in the first two years wanted in a computer. They toted the infrastructure with them into all contexts of their teaching experience: school, university, and home. The use of the computer lab has changed to included advanced multimedia and new methods for projection. During the two years (1995-97) when the lab and the College curriculum was beginning to include multimedia and the Web capabilities, some of the YLP students often made negative comments about the old black-and-white, slow, no-CD-ROM PowerBooks we were asking them to haul to their University classes.

Much of the need we were addressing in 1993 was the lack of access to computers in the K-12 schools. During the first few years of the TTA project, the PowerBooks we

provided our students were often the only computer in the classrooms where our student teachers were placed. Of course, more classrooms have computers now, albeit with varying degrees of sophistication and support. Most YLP students report having an adequate computer in their cooperating classroom, almost all with Internet access. When we consider these developments, we see why the students felt the PowerBooks were "underpowered".

But this year, we are noticing yet another shift in the modes of computer use. We have recently introduced two PowerBook printing and networking docking stations in the basement of the College. We were surprised to see how the YLP students made use of these. We had envisioned that they might use the network connection to browse the web and send e-mail in a quite space away from the lab. What we found was that the students did not care to use the network in these small study carrels but instead just used them for studying, writing on the PowerBooks, and printing. In this way, it became apparent that this most recent cohort of YLP students are employing different modes of computer use in different contexts. Not every student uses all modes the same, or at all. But the main point is that they are making personal decisions about how they computers. This is an emergent indicator of increasing skill, confidence, and acceptance with technology among the YLP students over the past five years.

To summarize, the technology infrastructure of the YLP changed from being a portable infrastructure used in multiple contexts to include multiple modes of computer use that varies by the context. All of the contexts in which the YLP students are using technology have changed significantly over the past five years. We have been dancing as fast as we can to keep up with these changes. But what is more important is how the YLP students have adapted to these changes and, because of the increase in incoming skills and their selection of preferred modes of computer use, they have determined how technology will be used in the YLP. In other words, we have adapted to them and their changing skills, beliefs, and experiences more than the technology.

Methodology

In the five year history of the YLP, the modes of instruction have changed dramatically. The initial group of students received very little instruction on how to use of the applications on the PowerBooks. There were a few whole group sessions of basic instruction, but for the most part, the laptop computers were distributed to the student teachers who were on their own to be able to use them. The major focus was on the use of email to facilitate communication between the professor, the teaching assistants, the supervisors, the cooperating teachers and the student teachers. The one experimentation involved electronic journaling. This effort was not successful in the first year because the instructors did not place limits on the amount of text submitted, and the instructors quickly became overwhelmed with the quantity of email received.

After the first year, the faculty and supervisors involved with the course asked for assistance from the technology faculty and graduate assistants involved with the TTA project. The course was structured to allow for one hour of technology instruction every Friday, and a team-teaching model evolved, with the YLP faculty meeting weekly with the technology faculty to plan sessions for the students. The "stranding" approach evolved in the second year of this initiative. At this point, however, instruction was still geared to those who needed help the most, for those most insecure with the technology.

By the third year of implementation, the methodology, driven by student demand and comments the students made on semi-annual evaluations, had changed drastically. In addition to presentations made to the whole group, lecture style, the students had more hands on experiences in the Instructional Computing Lab. Instruction included uses of email but by this time expanded to use of the web, multimedia software exploration and evaluation, and other related topics. Student evaluations called for more hands-on experience with technology. The College Computing Lab thus became a place where the students could experiment with multimedia.

By the fifth year of implementation, the methodology had changed again, with more topics of instruction, more small group work, and multiple choices of topics on given Fridays. The faculty and staff had recognized the great range of technology competencies among the student teachers, and instruction accommodated this diversity. Fewer whole group presentations were made; the students more often were able to select from several topics on a given Friday with instruction geared to differing abilities and interest. On a given day, clusters of students could be working on the web, on specific software packages, creating multimedia, learning how to use a digital camera, et. al. In addition, the faculty brought in guest speakers who were technology using elementary teachers from local schools. The local teachers' modeling of the use of technology proved to be an extremely effective means of presenting new ideas to the students.

By the fifth year, then, the student teachers experienced a whole range of mini workshops, most of them set up around small group instruction which was hands-on. The students themselves selected and suggested topics to the instructors. In the 1996-97 school year, workshops were characterized as being ability-grouped, hands-on, wired (i.e. connected o the Internet), taught in small groups on a variety of platforms, and offered on dual platforms. It became important to offer instruction on software on both the Mac and PC platform whenever possible.

A sampling of topics from workshops during the 1996-97 year includes the following: Microsoft Works and Wizards, HyperStudio, scanning and digitizing, evaluation of educational software, acceptable use policies and ethics, creating slide presentation with PowerPoint, resumes, reference materials on CD-ROMS, creating personal web pages, and using different methods of projection in the classroom.

Institutionalization

What began as a small pilot project within TTA has evolved to an institutionalized methods course which is serving as a model for curriculum redesign in the College of Education. Microsoft, as part of its College of Education Partnership, donated software earmarked for teacher training to both the PowerBooks and the College Instructional Computing Lab. Faculty and TTA research assistants worked in conjunction with College faculty from the Department of Curriculum and Instruction to team teach the technology component of the YLP.

The NSF funding of TTA ended in the summer of 1996. In the fall of 1996, the College established an Office of Educational Technology, created with non-recurring funds from the Chancellor's Office, to support faculty development and provide assistance in integrating technology into course work. During its first year, the OET staff worked closely with the YLP course as well as with several other methods classes (math methods, science methods, English methods.) At the College level, faculty began to plan for teacher education redesign—a means of reworking the teacher education curriculum beginning in 1998 to allow for stranding of technology on an infusion model into all the methods courses. Also in 1996, two faculty members began working on a technology competencies database - a matrix they were piloting to track a student's use of technology across all courses taken in the teacher education experience.

In 1997-98, the OET received permanent funding from the campus. It is continuing to focus on faculty development and integration of technology into the curriculum. Staff and faculty are gathering data on uses of laptops vs. desktops, student computer use patterns, and researching what other institutions of teacher education are doing to support student computer use in order to project an expansion in the future. Teacher education redesign is fine tuning its planning, with beginning implementation still scheduled for 1998. The Curriculum and Instruction Department has purchased a mobile multimedia unit for use by students and faculty in the department. This consists of a mobile cart outfitted with a high end computer with CD ROM, a color printer, a scanner, and a digital camera. This cart is housed near the department on the third floor of the building to give faculty and students more immediate access to these tools.

Conclusion

The success of the Year Long Program and its technology integration strand can perhaps be judged by the impact its has had on its graduates as well as the impact it has had as a model for future development in the teacher education curriculum at the University of Illinois. The participating faculty and staff's ability to adapt quickly to the numerous changes that have occurred in the hardware, software, network infrastructure, student experience, methodology, and course curriculum have been critical. A team approach, with curriculum and instruction faculty working hand in hand with instructional technology faculty and graduate students, meeting weekly to plan the technology integration component of the course, has been a significant factor in this group's adaptation to change.

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Developing a Need for the NCATE/ISTE Standards for Pre-Service Teachers

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Classroom instruction is undergoing a transformation. The push for this change emerges not only from reform and standards movements, but also from the sheer volume of information that must be relayed to students. Teachers are becoming information brokers as they work to relay needed information on to students and not always from a position of knowledge and authority. This move also makes the classroom more student-centered (Barron & Goldman, 1994). This change can and should be supported by information technologies. The pressure for teachers, particularly new teachers, to be proficient with information and instructional technologies is growing.

As pre-service teachers look to enter the workforce, they are beginning to find that their ability to demonstrate proficiency with computer technologies affects future employment possibilities (Davis, 1997). At the same time, college and universities who seek accreditation for their teacher education programs face a need to be able to demonstrate that their programs, faculty and graduates reflect these standards as well as be able to perform at a competent level. Specific performance criteria (ISTE, no date) have been developed by the International Society for Technology in Education and adopted by the National Council for the Accreditation of Teacher Education (NCATE). The foundation standards for all teacher education students include the following core principles:

A. Basic Computer/Technology Operations and Concepts. Candidates will use computer systems to run software; to access, generate and manipulate data; and to publish results. They will also evaluate performance of hardware and software components of computer systems and apply basic troubleshooting strategies as needed.
B. Personal and Professional Use of Technology. Candidates will apply tools for enhancing their own professional growth and productivity. They will use technology in communicating, collaborating, conducting research, and solving problems. In addition, they will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical, and legal use of computer/technology resources.
C. Application of Technology in Instruction. Candidates will apply computers and related technologies to support instruction in their grade level and subject areas. They must plan and deliver instructional units that integrate a variety of software, applications, and learning tools. Lessons developed must reflect effective grouping and assessment strategies for diverse populations. (ISTE, no date).

All colleges and universities that are accredited by NCATE must ultimately demonstrate compliance with these performance standards or risk losing their accreditation. Realistically however, schools may not attempt to meet the standards until the date for re-accreditation looms on the horizon. The reasons for avoidance are diverse and may range from a lack of knowledge about the new technology standards to a lack of faculty interest in and abilities with technology. It therefore becomes important to build a grass-roots demand for the inclusion and integration of instructional technologies in order to meet the needs of students.

Building Student Demand

There are multiple ways this campaign can be achieved. Individual faculty members could be the impetus by undertaking the task of teaching technologies in their own classes, i.e., make technology an integral part of assignments and class. Another choice would be to have educational technology courses attempt to cover all aspects of the standards in a cursory fashion (given the expanse of the standards). Another possibility is to expose the students to the standards and have the students create a demand for the inclusion and integration of all standards in the teacher education program. This final option is the focus of this paper.

At Indiana State University, all students do complete a series of technology competencies as part of their course-work in the 5-12 program. The competencies are an integral part of the teacher education program and success-

ful completion is required to move forward. These competencies provide basic introduction to use of the Internet, and presentation software. A handful of students develop more in-depth skills on their own or through other classes. Therefore, the majority of students do not have skills that would match with the standards described above.

Proficiency Exams

To build the student support and interest in these instructional technologies, an optional program was developed (Powers, 1997). Eight proficiency examinations were created which cover the major topic areas of word processing, spreadsheets, dataprocessing, electronic communications, desktop publishing, instructional applications, presentations/digital imaging, and concepts and societal implications of instructional technologies. Students can select any of the eight proficiencies, read the requirements to achieve competency on that standard, and then sign-up on-line to take a proficiency exam. The students then sit-down with the proctor and are asked to "perform" on demand. For example, as part of the word processing proficiency exam, students would be asked to complete the following:

- create a file;
- save a file;
- retrieve a file;
- modify text styles;
- include headers and footers;
- create and modify a table;
- modify page layout;
- insert graphics; and
- complete a simple mail merge.

If the student can successfully complete each of these skills, they pass that proficiency exam. Students then receive a certificate of completion along with a letter explaining the proficiency exam on departmental letterhead stationary. The benefit for students is that these artifacts can then be placed in a student's professional portfolio as a demonstration of proficiency to superintendents and principals while interviewing for professional positions.

Reality of Meeting Proficiency Levels - Students and Faculty

At present, the technology component in the secondary education program covers relatively well two of the eight competencies: electronic communications and presentation/ digital imaging. With some minor additional work, the majority of students in the program could successfully complete both of these proficiency exams. With only two of the eight covered, a big hole remains in the compulsory instruction. Students can achieve several of the competencies partially and sometimes fully through electives offered in throughout the university.

Going back to building a grass roots case, plans are in development to begin offering workshops to students to assist them in the development of these technology skills. Before the first offering of any workshop, the demand from students has already been significant as the students themselves recognize deficiencies in their knowledge base. As workshops increase the skills of those students who participate, students who are not able to participate in extracurricular workshops due to family and job constraints will begin to insist that these skills become an integral part of the teacher education program. The already developed workshops will then provide a core set of instructional materials.

There is an additional base level purpose for the development of the technology proficiency exams. By breaking up the standards into eight separate proficiencies, the skills themselves become manageable, not only to the pre-service teachers, but also to the in-service teachers who take graduate courses through the department, and more importantly, to the faculty who teach within the department. The ISTE/NCATE Unit Guidelines state:

Faculty Qualifications

Higher education faculty are knowledgeable about current practice related to the use of computers and technology and integrate them in their teaching and scholarship.

Resources for Teaching and Scholarship.

Faculty and candidates have training in and access to education- related electronic information, video resources, computer hardware, software, related technologies, and other similar sources.

Media, software, and materials collections are identifiable, relevant, accessible, and systematically reviewed to make acquisition decisions. There are sufficient library and technical staff to support the library, instructional materials collection, and media/computer support services.

Resources for Operating the Unit

Facilities and equipment are functional and well-maintained. They support computing, educational communications, and educational and instructional technology at least at the level of other units in the institution. (ISTE, no date).

These guidelines place a high burden on faculty members in teacher education institutions and raise the bar to a level not currently being met by a majority of faculty members. By creating proficiency examinations that are possible to grasp in small units, workshops, and potentially proficiency exams, can be offered to teacher education faculty in order to upgrade their own skills and abilities. The continued assumption is that if faculty also have the same proficiencies, the technology will be become a integral part of the teacher education program. Many researchers have shown the benefit that integrated media and technol-

ogy can have on helping teachers develop new models of teaching and learning (Barron & Goldman, 1994).

Conclusion

President Clinton articulated a vision of "Four Pillars" to support technology literacy which include hardware, connectivity, digital content and professional development. The recent School Technology and Readiness Report (STaR) by the CEO Forum (1997) indicates that schools have markedly increased the ratio of students to computers, as well as increased Internet access. However digital content and the professional development pillars are still missing. Superintendents and principals are right now seeking to fill these voids by hiring new teachers who are proficient with instructional technologies and can help train established school faculty and model the inclusion of digital content (?, 1997). Anything a pre-service teacher can do to communicate that they are proficient and competent with technologies, such as through certificates of proficiency, will enhance their employment opportunities and the ability of the schools to meet this need.

The standards cover many areas of technology. However, as reported in T.H.E. Journal (Davis, 1997), none of the skills are out-of-line with the needs and demands of employers, including educational employers. Building demand from the marketplace is just one method of finding room in the curriculum for instructional technologies. This program has just left the development process and is now entering implementation. Students are showing interest in the exams and signing up to participate. Hopefully, the technique will prove successful in this pre-service program.

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Enriching Middle Level Preservice Teacher Training Through the Integration of Technology

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Education clearly is and will continue to be impacted by new and emerging technologies. In 1996 President Clinton challenged America's schools to ensure each learner would become technologically literate by the dawn of the 21st century and further stated that "every classroom in America must be connected to the information superhighway with computers and good software and well-trained teachers" (Winters, 1996). In the School Technology Users Task Force Report (N.C., 1995) basic technology competencies were established for all preservice teachers to ensure that educators in the future can integrate instructional technologies into student learning. Attainment of these competencies would enable educators to deliver effective teaching and to enhance overall professional productivity.

According to the Office of Technology Assessment (1995) 5.8 million computers

are available in America's elementary, middle, and secondary schools. Students continue to exhibit high levels of interest in technology as a result of their varied experiences with technologies. Yet, teachers continue to fail to integrate technology into instructional planning. Lack of teacher training and limited access to technology (Becker, 1994, Lucas, 1976) are cited as reasons for limited use of computers in classrooms. No longer can the 1300 colleges and universities across the United States ignore this issue. These institutions must be in the vanguard of change and provide a technology enriched curriculum that will adequately prepare preservice teachers for meeting the challenges that lie ahead.

Purpose

The purpose of this study was to assess the basic and advanced technology competencies of middle level educators in a preservice training program. Results of the initial survey were used to diagnose the skills of these university students and to determine areas of weaknesses to target for remediation in the ensuing methods courses. Additionally, these preservice teachers were given the opportunity to gain the proficiencies needed to pass the state mandated technology assessment scheduled for the upcoming semester. Ultimately, this experiment assisted these middle level education students in learning to work as collaborative members of interdisciplinary teams to provide quality instruction for their students.

Methodology

Survey and qualitative methodologies were used in this study. Data were collected from pre and post self-assessment of technology competency surveys. A questionnaire of ten opened items required written narrative responses. Semi-structured, exit interviews were also included in the data collection process.

Participants

Eleven students enrolled in the Middle Grades Program in the Reich College of Education at Appalachian State University were selected to participate in this study. Three of the students were seeking certification only and eight were undergraduates pursuing an undergraduate degree in Middle Level Education. In this cohort of students, four were preparing to teach language arts and social studies, three were preparing to teach mathematics and science, two were preparing to teach social studies and science, and two were either a science concentration only or a social studies concentration only. Their current schedule included an intense ten weeks of methods courses followed by a six-week internship in a middle level school. All students were scheduled for a sixteen-week student teaching experience the next semester. Ten participants were female and one was male.

Instruments

The Survey of Basic and Advanced Technology Competencies (N.C., 1995) was selected for data collection. This instrument contained 113 questions ranging from basis skills to more complex technological practices. The items were divided into the following categories.

1. Computer Operations
2. Setup, Maintenance, and Trouble Shooting
3. Word Processing/Introductory Desktop Publishing
4. Spreadsheet/Graphing

5. Databases
6. Networking
7. Telecommunications
8. Media Communications
9. Multimedia Integration
10. Curriculum
11. Subject Specific Knowledge
12. Design and Management of Learning
13. Child Development
14. Social, Legal, and Ethical Issues

Students were asked to indicate familiarity to the 113 items by checking yes or no to each one. This instrument was used for preassessment at the beginning of the semester and as a postassessment instrument to determine growth at the end of the semester.

The Student Technology Questionnaire allowed students to respond to the following questions.

1. How do you think technology will influence your role as an educator?
2. Are you aware of the technology competency requirements for education majors? If so, how did you acquire this information?
3. List below the previous/current courses in your teacher education program that have included opportunities to practice and/or apply the technology competencies. Describe the expectations for application in each course.
4. What procedures will you follow in acquiring the information necessary for you to master those competencies?
5. How could the College of Education facilitate your mastery of these competencies?
6. How will participation in an interdisciplinary team be an asset in terms of acquiring technology competencies?
7. How will increased competency in technology enhance your delivery of content area instruction in the middle school classroom?
8. To what extent do you anticipate middle level students will play in increasing your knowledge of technology?
9. How will you overcome obstacles in the school where you are placed as you integrate technology?
10. How can you be a change agent for technology in the public school?

Students were also asked to respond to this survey at the beginning of the semester and at the end of the internship experience which followed the ten-week block of methods courses.

Results and Discussion

The results of The Survey of Basic and Advanced Technology Competencies pretest revealed students were most proficient in Word Processing/Desktop Publishing and Spreadsheet/Graphing with over 90% responding positively in these areas. However, only 9% of the participants had previous exposure to multimedia integration.

Traditionally, teacher education institutions have been slow in integrating authoring programs in hypermedia (Reehm, 1994). Yet, it has been determined to be a powerful tool for teachers in the areas of instructional presentation and student engaged learning (Blanchard & Rottenberg, 1990, Reinking, 1997, Sholten & Whitmer, 1996).

Competency	Pre	Post
Computer Operations	64.71%	89.83%
Setup Maintenance and Troubleshooting	49.49%	78.78%
Word Processing/Introductory Desktop Publishing	91.92%	100.00%
Spreadsheet/Graphing	90.91%	97.40%
Database	57.58%	87.27%
Networking	22.73%	59.00%
Telecommunications	55.68%	68.18%
Media Communications	50.35%	88.11%
Multimedia Integration	9.09%	72.72%
Curriculum	53.03%	83.33%
Subject-Specific Knowledge	75.00%	100.00%
Design and Management of Learning	57.14%	85.71%
Child Development, Learning and Diversity	34.09%	63.63%
Social, Legal, and Ethical Issues	63.64%	90.90%

Figure 1. Comparison of Pre- and Post Survey Results by Category

To address this area of weakness, the methods professor and the university technology specialist revised the course syllabus to incorporate a training session for hypermedia use. Hyperstudio was selected as it was readily available to the students in an open computer lab, after their training. Students were introduced to the program and were given suggestions as to how the middle level educator might incorporate its use in content area instruction. As a total group assignment, the middle level preservice teachers created a hypermedia stack on "Interdisciplinary Teaming" to display their knowledge of the use of this software. Sound effects, fading, and buttons were added to the stack. Limitations included time for the students to create further nonlinear programs relative to other content areas in methods courses.

Post test data revealed growth in all fourteen competency categories. Students indicated the most significant growth in the area of Multimedia Integration. Initially, 9.09% of the students felt competent in this area. At the conclusion of the course, 72.72% expressed increased confidence in their abilities and knowledge in Multimedia Integration. Other areas where more than a 30% increase of growth was noted included Database, Networking, Media Communication, and Curriculum.

The narrative responses in The Student Technology Questionnaire indicated that all respondents were aware of the tremendous impact technology will play in their future role as educators. The majority of the students have had two or more previous courses in computers and in related technologies. Only two of the eleven surveyed were unaware of the computer competency test required of teacher education graduates in North Carolina. All respondents felt a need for further workshops, seminars, personal study, and integration of technology into methods courses, internships, and student teaching to prepare for the examination. One key need indicated by students was for more availability of computers in university classrooms and in labs. As middle level educators, students felt participating on an interdisciplinary team would be an asset to them when new technologies emerge. Collaboration and peer teaching will improve overall instructional planning and the integration of technology into all content areas. All students planned to exit the university as change agents in their future teaching assignments. The majority surveyed indicated a willingness to be not only an advocate for technology in the classrooms, but to petition administrators, local governing agencies, and businesses to seek additional funding to acquire needed technologies if classrooms had outdated or limited resources.

Exit interviews conducted with the students confirmed their earlier perspectives. These interviews occurred after a five-week internship in a middle level classroom. These preservice teachers were able to articulate in detail ways in which they see technology impacting classroom instruction and their performance as a teacher. For example:

As an educator, technology is a great resource. I was amazed to discover a sample text (book) in my classroom that had an accompanying CD. I could not believe that my (cooperating) teacher had not checked out what was on the CD. When I cheked, I found a wealth of varied information.

Technology will influence me as an educator. But I think it will happen a little bit at a time. I learned Hyperstudio and scanning techniques among other things. As an intern I am seeing very little of these in practice. I am glad that I learned what I did but it will be a few years before the school system implements all of this technology.

Technology can reinforce concepts that are being studied. Personally, I am considering graduate studies in technology education because I feel that our students need to understand technology and be able to use it if they are going to be successful in today's society.

Conclusions

At the conclusion of the internship experience, results indicated 72.72% of those surveyed expressed knowledge of Multimedia Integration. Significant growth was documented in all other areas of the basic and advanced competencies during the semester. Students expressed positive attitudes regarding the new emphasis on technology as well as the diagnostic and prescriptive efforts made collaboratively by the preservice faculty member and the technology specialist at the university. Students exited the semester with a higher level of confidence in all technology related areas. Additionally, they acknowledged the challenges of technology integration faced by classroom teachers due to the limitations of equipment, training and support. They emerged with a strengthened desire and increased knowledge to be a change agent in their respective schools of employment.

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A Dynamic Model for Technology Integration in a Learning Organization

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This project relates to the redesign of the teacher education program to address the technology proficiencies desired by the schools, recommended by the National Council for the Accreditation of Teacher Education, and delineated by the professional technology associations. This project encourages faculty to explore new technologies and provide a model of technology integration into curriculum delivery. This research effort identifies the basic technology proficiencies of approximately 400 Texas Woman's preservice teachers and presents the curriculum plan which evolves from the findings. Additionally, this project provides a baseline of data and planning which can serve as a foundation for ongoing research related to educational technology.

Introduction

In these times of rapid technological change the schools have needs for teachers who utilize diverse technology productively, who can contribute to campus and district technology planning, and who integrate technology into the curriculum. This includes the use of advanced forms of hypermedia, optical data, and global connectivity. These goals are congruent with the Texas Woman's University strategic plan and require an accurate assessment of our current curriculum for preservice teachers. Therefore, a new program design is evolving which reflects the guidance of the literature and the goals of the society.

Curriculum Development

The field of educational technology is struggling to move beyond measuring teacher attitudes surrounding technology or acquiring hardware and learning basic programming skills to educational productivity and curriculum development. The National Council for Accreditation of Teacher Education (NCATE, 1997b) in its description of preparing for the 21st Century classroom emphasizes the need for a vision of a teacher education program which fully utilizes information technology. Such a vision requires major adaptations: (a) greater understanding of the impact of technology on our society, (b) new roles as authority over knowledge moves beyond the teacher and the classroom, and (c) the emphasis on the ability to organize and interpret information and assess quality of information and sources in a reflective and critical manner.

In order to accomplish such a vision, preservice teachers must participate in formal courses designed to encourage the development of teachers as fearless users of technology (NCATE, 1997a) and at the same time offer an integrated and collaborative program which seeks to encourage this development through meaningful activities within authentic context. Some of these courses will encourage risk taking and lifelong learning through instructional delivery in non-traditional ways such as distance learning and on-line classes. NCATE further recommends that stimulating effective utilization of technology through a vision and plan would include integration across all areas of curriculum in the teacher education program.

Across the nation, professional development schools link teacher education institutions with field training in K-12 schools. Barker (1995) describes the Professional Development School (PDS) at Western Illinois University implemented with a large AmeriTec grant. The critical components are: (a) distance education technology linking to the public school; (b) a teacher education curriculum that integrates instructional delivery, communications, computer application and resource development; (c) the linking of technology resources to curriculum development and various teaching strategies; (d) training faculty to model integration of technology, and (e) acquisition of the technological resources for faculty and students at both university and school sites. Such a vision is congruent with the mandate for Texas professional development schools.

Within the design of a Professional Development School (PDS) Model at the field-based setting, inservice teachers recognize the need for changes in the preparation of preservice teachers (Fisher, 1997). The students must be able to concentrate on advanced educational technology skills. They must be able to examine curricular issues involving instructional technology within their programs of study. The value of technology in the schools is dependent upon the preparation of the teachers. Their preparation is

dependent upon the teacher education program as designed and implemented by the faculty.

At the university level in the PDS, specific technology issues continue to be revisited. As faculty shape the teacher education curriculum, key factors must be in place. Faculty must engage in active collaboration in planning for the systematic, ongoing integration of technology. They need to model a multi-faceted approach including critical thinking and reflection (Parker, 1997). They also need to ensure that students' prerequisite skills are in place (Rodriguez, 1996). This may involve a foundations course in educational technology, distance learning, local workshops, individual mentoring, field trips, learning buddies. The required facilities and materials must be available. Instruction must be focused, hands-on, and lead to success.

"If the role of teacher education programs is to produce teachers who are able to use the new computer technologies, we must take our preservice teachers from where they are when they enter and advance them to where the technological society needs them to be" (Sheffield, 1996, p. 52). Performance-based programs are measured in terms of competencies or proficiencies (Buhendwa, 1996; Flowers, 1997; Woodrow, 1991). Thus, educational needs at all levels can only be reached when our preservice teachers are able to model the desired proficiencies identified in educational technology programs designed around an integrated teacher education vision.

Design and Refinement of Dynamic Program Model

This project relates to the redesign of the teacher education program to address the technology proficiencies desired by the schools, recommended by the National Council for the Accreditation of Teacher Education, and delineated by the professional technology associations. The project encourages faculty to explore new technologies and provide a model of technology integration into curriculum delivery. These efforts are reflective of the Texas Woman's University strategic plan as it relates to the preparation of future teachers. Several of the strategic plan's major goals call for incorporating technology into higher education instruction and delivery. This project addresses college and institutional goals in relationship to technology and preservice teacher education. Additionally, this project provides a baseline of data and planning which can serve as a foundation for other funding and ongoing research related to educational technology.

Identifying Need

This research effort identifies the basic technology proficiencies of approximately 400 Texas Woman's preservice teachers, compares the differences in proficiencies between two teacher education programs, and presents the curriculum plan for educational technology which evolves from the findings. The dependent variable is the Basic Technology Competencies for Educators (BTCE) developed by the research team at University of North Carolina at Charlotte (Flowers, 1997). Independent variables include the alternative programs, and three levels of experience. The quantitative part of this study uses an ANOVA repeated measure design, and MANOVA for interactions for independent variables.

The Basic Technology Competencies for Educators (BTCE) is a self-report summated rating scale which is divided into nine-competency domains: (a) basic computer operations skills, (b) setup, maintenance, and troubleshooting of equipment, (c) word processing, (d) spreadsheets, (e) database, (f) networking, (g) telecommunication, (h) media communication, and (I) social, legal, and ethical issues. Within each domain five items are given. The fifth item is a summary for that dimension.

Flowers (1997) used the 207 skills identified by the Association for Educational Communications and Technology (AECT) and the International Society for Technology in Education (ISTE) as the foundation for the Basic Technology Competencies for Educators (BTCE) which is the measure selected for this research. The nine-dimension, 45 item scale uses a four-point scale documenting degrees of competency: (a) non-user, (b) extensive assistance, (c) minor assistance, (4) proficient user. Ten scores summarize the total technology competency score and each of the nine domains.

The validity and reliability study of the BTCE supports its psychometric qualities as an instrument to be used for assessing teacher education programs or conducting research (Flowers, 1997). Three classic methods were used to provide evidence of validity: content validity, criterion-related validity, and construct validity. Two types of reliability were examined: stability and internal consistency. Test-retest reliability coefficients range from .73 to .93. The internal consistency, for the total test score and each domain was measured using Cronbach's alpha which ranged from .87 to .97 indicating high internal consistency. Thus, the total score and all the domains have adequate homogeneity.

Program Integration: PreService Teachers

Needs Assessment Findings: Based on the findings from a preliminary needs assessment examining the preservice teacher population at Texas Woman's University a program model addressing four basic areas: (a) Foundations; (b) Connectivity; (c) Productivity; and (d) Integration has been designed and will continue to undergo refinement based on research findings from the Preservice Teacher Technology Proficiency Survey.

Foundations

This program component will address knowledge of computing systems, developing basic skills of computer

operation, examination of the evolution of technology and encourage users to begin to think with technology. Additionally, The social, legal & ethical issues pertaining to using technology in an information society will be addressed. An overview of University technology resources including The Information Technology Service provisions for students and Information Technology Library Services will be provided. This program component will be conducted at the pre-Intern level.

Connectivity

This program component will provide students at the Intern I level the information and skills needed in relationship to connecting on campus as well as remote access issues. Both the University system, Venus, and the use of a World Wide Web browser, Netscape, will be utilized by students as they are involved in various e-mail and connectivity projects including tele-mentoring, e-mailing assignments to liaisons, and communicating with other field-based participants through web-pages, electronic bulletin boards, web-based forums, and list-serves. Managing electronic documents and issues of netiquette and confidentiality will be examined.

Productivity

This program component will provide students at both Intern levels I and II the necessary skills for teacher productivity. Intern I will focus on word processing, data base and spreadsheet. Intern II will focus on advanced skills for teacher productivity and integration into curriculum. The use of desktop layout, managing graphics, and presentation tools will be addressed.

Integration

Integration as a program component is delivered at both the Intern II level and the Resident level. Intern II will focus on learning theories and technology integration models, the examination of student technology tools (tutorial, simulation, exploratory, problem solving, and multi-media) and integration into various curriculum areas. Advanced forms of media including optical technology, internet resources, and related multi-media hardware and software will be utilized in the creation of student projects. The use of global classrooms, on-line education, and distance education will be included. Additionally, students will learn networking skills, set-up and maintenance skills, and participate in planning for technology at the campus level.

Educational Technology Mentor Team: A team of technology mentors will be established within each of the three CCPDC groups (Intern I; II & Residents). These teams will be trained on:

Intern I:

Netscape
Venus
Claris Works: WP; SS; DB

Intern II:

Claris Works: Slide Show; Desktop Layout
Power Point
Hyper Studio

Residents:

Web Page Editors
Advanced Forms of Multi-Media Hardware

Tech. Teams:

Establish Tech. Teams within each of the three CCPDC groups. These teams will operate according to the cooperative learning model with specific role assignments, one of which will be the team leader. During certain technology seminars the technology mentors will work with team leaders on various pieces of software. Team leaders will disseminate skills and information to individual groups.

Tele-Mentoring Project:

Tele-mentoring partners will be established among the three CCPDC groups. This project will support the evolution of advanced use of technology and facilitate the development of reflective teaching practices.

Educational Technology

Organization for Pre-service Teachers: This student organization will provide support for those students who are interested in advancing in their use of technology tools and learning to think with technology.

Role of Technology Seminar Leaders:

Technology Seminar Leader will function in the following roles in the instructional delivery process:

- train educational technology mentors
- construct tech. teams
- facilitate team projects:
- provide additional resources
- provide necessary background knowledge
- make connections to the field site
- facilitate and encourage communication and provide for individual development through the effects of and with technology through a tele-mentoring project, student technology club and the use of a web site for instruction.

Indicators of Student Achievement:

Intern I:

Students will produce documents related to the development of Teacher Productivity Skills. These documents will include a parent letter, student data base, and grading spreadsheet designed for individual field placements.

Students will describe the use of technology at their respective field sites.

Intern II:

Students will produce documents related to the development of advanced Teacher Productivity Skills. These documents will include a newsletter and the use of presenta-

tion software for lesson delivery designed for individual field placements.

Students will describe the use of technology at their respective field sites and include a plan related to recommended modifications for a future technology plan. This plan will include the evaluation of software located at each field site and a plan for implementation at the classroom level.

Residents:

Students will design student projects using advanced forms of media including internet resources. These projects will be implemented at the respective school sites utilizing tools mastered in the previous intern experiences.

Students will describe the use of technology at their respective field sites and include a plan related to recommended modifications for a future technology plan. This plan will include the evaluation of software and technology resources located at each field site and a plan for implementation at the both the classroom level and school wide setting.

Program Integration: University Faculty

Needs Assessment Findings - A purposive sample of current faculty identified perceived critical needs in the areas of Productivity, Connectivity and Integration.

Productivity

A first priority that included Power Point presentations, creation of a personal Web Page, and the development of multimedia presentations. Special training sessions will be scheduled by the Information Technology Services (ITS) for CCPDC Academic Faculty. These sessions will be offered during Monday seminar times when liaisons do not have field schedules. The liaisons will develop Power Point presentations for routine use in classroom instruction. A second instructional goal is development of personal web pages for use in classroom instruction and communication with preservice teachers. When liaisons have developed these two skills and begun to use them routinely in classroom instruction, they will participate in training to extend their multimedia presentations with more advanced media tools, i.e., the cameras, optical technology, laser disks.

Connectivity

Use of the WWW, connecting with students, and connecting with peers in the global community. This includes establishment of forums, chats and listservs, using Netscape or Eudora to send class messages and manage e-mail files, and using a personal web page to communicate with students. Faculty currently have E-Mail available for routine campus communications, and many use a service provider at home for additional services. However, they perceive a need for training to support the use of forums or chat rooms as part of electronic class discussions, of training to manage more efficiently responses to student E-Mail, and management of accounts.

Integration.

Integrating technology into the curriculum as taught in the university, and as taught in K-12 education. This also includes the use of advanced forms of media such as optical technology, scanners, video and sound, digital and document cameras, and interactive laser disks. Of special interest because of its integral place in the TWU Strategic Plan is the need for training in distance education. The University is committed to the development of more on-line courses, participating in global classrooms, and extending its video conferencing. To date, a number of courses have been taught successfully, and video conferencing between our Denton/Houston/Dallas campuses is routine. Faculty need training in use of Internet resources to use with various content areas at various levels as well as use of appropriate CD-ROMs and content-specific software. The evaluation of software and of the teaching/learning processes are an intrinsic part of the training in this area.

Program Integration: Mentor Teachers

Conduct Needs Assessment

Mentor teachers have identified their need for more technology training. Approximately 360 mentor teachers are involved each semester. The eleven school districts in CCPDC vary in training provided and in their platform choice. The mentor training needs to provide a series of choices, some of which would be sequential. The training could be conducted by university, district, or service center personnel. The annual needs assessments need to be completed in January so that plans can be made for summer training, and the schedule for the next year established. A subcommittee of the advisory counsel needs to direct this activity.

Collaboratively Plan Yearly Schedule

In order to involve district personnel, the yearly schedule needs to be established and publicized in the spring, prior to the design of school calendars. The yearly schedule requires a recognition of district variations in schedule, class size, training resources, and rotation and sequencing of sessions.

Implement and Evaluate Training

The training will be routinely evaluated and reviewed by the technology committee for modification, repetition, and rescheduling. Evaluation is standardized, reviewed by the committee, and used as a basis for revision and enhancement.

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The Technology Competencies Database: Computer Support for Assessment, Teaching, and Portfolio Management

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The teacher education programs at the University of Illinois in Urbana-Champaign have no single, foundational course in instructional technologies. Rather, we work with our instructors to infuse relevant and appropriate instructional technologies into each course in our teacher education programs. Recently, NCATE adopted the ISTE-developed standards that identify the critical instructional technology concepts/topics that should be included in all teacher education programs. Given the distributed structure of our approach to incorporating technology into our programs, we felt the need to develop a software tool that would assist instructors in situating specific technology experiences within a series of courses. In additi we needed a system that would enable instructors to collaborate effectively in assessing students' competence regarding each standard. Further, we wanted a system that would provide student access to their records and an easy means of submitting evidence in support of their attainment of the required skills and experiences.

To meet this need, we developed the Technology Competencies Database, a World-Wide Web-based software tool that will enable a group of faculty to collaborate more effectively in providing technology experiences to their students. The TCD is a FileMaker Pro database running on a Macintosh computer that is also a World-Wide Web server. Students and Instructors interact with the system at any time of day and from any location using any web browser software.

The TCD contains individual records for each student and enables them to submit statements and materials in support of their attainment of the ISTE/NCATE standards (which we refer to as the Technology Competency statements). These submissions are accessible by the students' instructors; and the students and instructors may exchange messages regarding the competency statements, the students' submissions and any additional work which will be required by the instructor.

The students' submissions and the faculty responses are all preserved in the database and can be sorted in various ways to provide the faculty with reports regarding where each competency is addressed in each program and, most importantly, what kinds of activities each faculty member is accepting as evidence that each competency has been met.

The TCD system may be very valuable in helping us to ensure that each student is being held to the same standards of performance. In addition, it will help us to demonstrate where and how each technology competency is acquired by our students. Further, it will allow the students to create an electronic portfolio of their technology expertise.

Introduction

Thirty-two states already require technology training as part of their certification requirements for teacher licensing (Zehr, 1997). In line with this trend, the National Council on Accreditation of Teacher Education (NCATE) is adopting comprehensive guidelines for what teachers in training ought to learn about uses of educational technology (Guernsey, 1997; NCATE, 1997). Although a requirement for the "technology competencies" is not yet in place in all states, teacher educators know it is only a matter of time until they appear, in part because of the rapidly increasing funding for classroom-based learning technologies. In such an environment, it is perhaps not surprising that instructional technology is growing rapidly in importance among teacher education programs.

One way to deal with technology competencies is under way at the University of Illinois at Urbana-Champaign (UIUC). We developed the Technology Competencies Database (TCD), a web-based resource being implemented in the undergraduate education program at the College of Education. In the fall semester of 1997, 57 senior-year undergraduates majoring in elementary education are being introduced to the TCD as part of their coursework. The TCD offers students a chance to tell their professors what

they know about aspects of educational technology, and gives the professors the chance to award credit to the students for their knowledge.

This paper describes a formative evaluation study of the process of implementing the TCD in our teacher education programs. Technical, educational and social issues relevant to the innovation are described, with attention given to the views of diverse stakeholders including teachers, students and the TCD designers. Conclusions and recommendations appearing in the study deal with a broad range of implementation issues within and beyond the immediate context of use.

Overview of the ISTE/NCATE national standards

NCATE is a Washington, DC-based coalition of 30 national organizations that sets standards for education schools and accredits about 500 teacher training programs nationwide (Bradley, 1997). Recently, the International Society for Technology in Education (ISTE) recommended technology content guidelines to NCATE for programs in educational computing and teacher preparation. The ISTE guidelines encompass five general areas: 1) recommended foundations in technology for all teachers; 2) educational computing and technology literacy - endorsement; 3) secondary computer science education - endorsement; 4) secondary computer science education - bachelor's degree, and 5) educational computing and technology leadership - advanced program (ISTE, 1997). NCATE adopted these guidelines for use in the accreditation of teacher education programs beginning in the fall of 1998. The first area, "recommended foundations," lists eighteen competencies which all teacher education programs should address. These are divided into three categories: Basic Computer/ Technology Operations and Concepts, Personal and Professional Use of Technology, and Application of Technology in Instruction. (A list of these competencies appears in the Appendix.)

In mid-September 1997, an NCATE task force released a 32-page report warning that new teacher graduates are not being adequately prepared to use technology in their teaching (Bradley, 1997; Guernsey, 1997). This report urges that technology topics be integrated fully into the curricula of teacher training courses, rather than being ignored or treated as an optional add-on. In addition, the task force report urges NCATE to work with other professional organizations to encourage education schools to use modern communications technologies, and to identify and promote examples of exemplary practices. Among other recommendations, one particularly relevant to the efforts described in this paper is a suggestion that teacher education programs post student portfolios for electronic review (Bradley, 1997).

Teacher Education at the University of Illinois

The TCD project is taking shape at a time of major change in the College of Education at UIUC. In fall 1998, two redesigned teacher education curricula (elementary and secondary education) will begin which will include both classroom work and extensive internship experiences in the public schools. All majors in elementary education will be placed in public schools as student teachers for their entire senior year. Secondary education students will not graduate as education majors at all—instead, they will be majors in the subject areas of their specializations, and will meet state certification requirements by minoring in the College of Education. These secondary education students will spend an intensive final semester engaged in two field placement settings—one in the middle grades and the other in high school.

Throughout this redesigned curricula, technology is to be a recurring strand within a spiral curriculum; junior- and senior-year students will explore educational technology issues as part of at least four courses within the College's curriculum. (The other recurring strands are "diversity," "special populations," and "evaluation.") Such an approach requires that students be made aware and encouraged to explore educational technology use in a systematic yet highly fluid manner. This need has led to our development of the Technology Competencies Database.

The Technology Competencies Database

For the past three years, senior-year students majoring in elementary education in the College have had the option of enrolling in the Year Long Program (YLP). The YLP served as a pilot program for our newly redesigned elementary education curriculum. Students in the YLP spend two to three days a week teaching at public schools in the fall semester, and move to a five-day-per-week placement in the spring. In the spring of 1997, 40 YLP seniors were introduced to the Technology Competencies Database (TCD). Based on their experiences with the TCD, we modified the program and used it with another group of 57 YLP students in the fall of 1997.

The TCD works by linking a server-based database program to a web interface, allowing users to update, change and delete information via web-browsing software. At present, the resources in place are a Power Macintosh computer used as a server, FileMaker Pro 3.0 database software running on the server, WebStar 2.01 server software, and a WebStar add-on called Lasso, which allows information to be passed between FileMaker Pro and Internet web browsers.

Using the TCD via web-browsing software, the students described how they met some of the competencies laid out by NCATE and ISTE. They may also have provided a link to a web page with supporting information. The instructor

uses the TCD to respond to the students' descriptions, either by awarding credit or by requesting additional information. In addition to providing these means for individual student-teacher interaction across the network, users also can see successful completions of various competencies by the students; the result is a system which grows more useful as more users contribute to it, with standards that are operationally defined through use.

Purposes of the TCD

The TCD is intended to give students a way to communicate their experiences with instructional technologies to the faculty, and for the faculty to assess the students' accomplishments in these specific aspects of instructional technology. While many of the students' experiences might be gained through participation in courses in the teacher education program, this mechanism will also permit students to earn credit for experiences gained through other means. Due to the large number of students in our programs and our need for multiple faculty to have simultaneous access to the students' records of performance, we felt that an on-line mechanism for student-teacher interaction and record keeping would prove to be the most efficient, effective and convenient means for infusing the technology strand through the courses in our programs.

We see the TCD as a mechanism that can provide some essential structure to independent learning. One participating faculty member has suggested that the TCD might be made more flexible by having students nominate areas of technology expertise themselves, rather than responding to the list of competencies provided by ISTE/NCATE. Even in its present form, the faculty involved see the TCD as representing a portfolio approach, in that students are in control of the content they submit, and that they are creating a coherent summary of their work which may be used later as evidence of achievement.

Analysis of the Spring 1997 TCD pilot study

During the spring semester of 1997, 13 competency areas were included in the TCD. These were the original set of standards recommended by ISTE/NCATE. (Changes made by ISTE/NCATE in mid-1997 resulted in 18 rather than 13 standards.) In the spring 1997 version of the TCD, students were rated as having achieved at one of three levels of accomplishment for each of the 13 competencies; in general, Level 1 represented basic familiarity with a competency, Level 2 indicated that the student had used the competency with elementary-school sessions, and Level 3 showed that the student teacher had made the competency an integral part of an extended set of lessons in the elementary school (Levin, 1996).

An evaluation of the TCD implementation in spring 1997 revealed strengths and weaknesses (Moore, 1997). On the positive side, students reported high interest in using the TCD, particularly because they thought it would prove useful in job searches. As negatives, students listed the slowness of the system (it has since been made considerably faster to use), and the long waits many of them experienced between submitting information and receiving any response from their instructor.

Analysis of the TCD responses following the Spring 1997 semester showed that of the 40 students in the YLP, only seven had successfully completed any of the competencies. Eight students had submitted descriptions which received no response from the instructor, and five students had neglected to respond to the instructor's requests for additional information about one or more of their descriptions. Furthermore, only 25 of the 39 competency/level combinations had been attempted by any of the students.

These findings led to substantial revisions in the TCD over the summer. The TCD was updated to reflect the new 18-competency version of the NCATE standards, and the three-level performance distinction was eliminated. In the current version of the TCD, students are asked to describe a single level of completion for each of the 18 competencies; the instructor is given the choice of withholding credit pending more information, awarding a rating of acceptable, or awarding a rating of exemplary/outstanding.

Evaluation of the Fall 1997 TCD trial

In the fall of 1997, formative evaluation techniques were employed to seek an understanding of the diverse viewpoints of the various stakeholders involved in the implementation of the Technology Competencies Database project. Through these efforts, we gathered information from students and faculty members via surveys, personal interviews and direct observations. We then used this information to modify the design of the TCD throughout the semester. Although this departs from traditional research designs in which evaluators refrain from direct interference in the projects they are examining, we felt that the benefits of a hands-on approach outweighed any purity of purpose that might otherwise be achieved; that is, it was reasoned that if the purpose of evaluation is to inform practice, the greatest benefits would be achieved by applying the information gained as soon as possible, so that participants would not have to continue dealing with inefficiencies which might easily be remedied. Among the changes which resulted from this approach during the semester were improved instruction sets and programming changes to maximize the speed of interacting with the database.

The evaluation conducted during the fall consisted of four main phases: 1) participant observations at the time of students' initial introduction to the TCD; 2) distribution, analysis and collection of surveys given to the students at the time of introduction; 3) interviews and discussions with a faculty member participating in the TCD project; 4) interviews with two students who used the TCD extensively. Each phase will be discussed below.

Introduction of the TCD to students in fall, 1997

The students were introduced to the TCD in late September. At that time, forty students submitted responses for at least one competency area. This occurred despite remarkably slow response times from the network, owing to the large numbers of simultaneous users on what is essentially designed to be a one-at-a-time database program. (Particularly slow were page updates, which are made when users submit new information to the database. Each took about 20 seconds, so in cases where as many as fifteen users submitted requests almost simultaneously, the last requests in the sequence would take nearly 300 seconds, or five minutes, to be processed.)

Thirty of the 57 students returned surveys which were distributed to them at the time of their introduction to the system. In these surveys, they were asked to write briefly about their likes and dislikes regarding the TCD, about what changes they would like to see, about anything they found confusing, and about how they thought the TCD might be useful to them.

Fourteen students said they liked the way the overall operation of the TCD, with five reporting that it was user friendly, seven commenting on its ease of navigation, and two commenting that the directions were self explanatory. Four respondents commented favorably on the efficiency of using the TCD: one called it "effective," another reported that it was "not very time consuming," one appreciated being able to use it "on my own time," and one remarked favorably about being able to provide a narrative description of abilities.

The negative comments from students largely fell into two major categories. There were seventeen complaints about the speed of the system, and twelve about the wording of the competencies themselves. One respondent commented that it was difficult to decide what to write about, and another complained, "it's just another thing to do. " Similarly, suggested changes included twelve requests that the standards be rewritten to make them less confusing, and four requests for faster programming. One student suggested that designers might explore "a more specific way of testing these skills," rather than relying on self-reporting by the students. In writing about what they found confusing, sixteen students commented on the language of the descriptions (They did not understand the wording of the competency statements.); four others were confused and irritated by a programming error which brought up an incorrect response page (the error was fixed immediately after the session).

Finally, in responding to how the TCD might prove useful, seventeen students commented that they hoped to show their records in job interviews or as a part of portfolios for potential employers to see. "It will make me more marketable," wrote one. Eleven responses dealt with personal goals; three students said the TCD would encourage them to learn more about computers, five saw it as a tool for self-assessment, and three said it helped them to realize what they didn't know. One student wrote that "meeting future national standards" was a useful goal.

Changes resulting from the survey responses

As a result of the students' responses, two independent efforts were made to clarify the intent of the standards. The instructor of the YLP group prepared one set of descriptions to help the students understand the competencies. He distributed his comments to the students on paper. In addition, the authors of this paper also paraphrased and revised the statements and added these to the TCD via hyperlinked text. This duplication of effort was in part due to lack of communication between the authors and the instructor, but it resulted in the creation of two good sets of plain-language descriptions which may be combined for even better results. By going through this process, the instructor became more aware of the standards he would actually employ in deciding how to award credit to students.

Discussions with the YLP course instructor

Following introduction of the TCD, the programmer met several times with the students' instructor to show how the system could be used efficiently, and to explore areas where the TCD might be improved. In general, the instructor spoke quite favorably about the TCD's ease of use, and about what it has enabled him to learn about his students' abilities. However, he expressed concern about finding ways to devote time to the task of marking responses. He devoted considerable effort to the job at times, as can be seen in e-mailed comments: "I worked for about 45 minutes on 10/15/97 to react to all YLP in section #2, who had responded to standard #1. I did not count, but I estimate 15-20 students in section #2 had noted something on some standard. I did not really refer to the responses I had created when reacting to section #1. Also found that I gave only one exceptional grade. Maybe I am becoming harder to please. The constant rereading of the standard and student responses certainly helps clear things up." Several days later, he wrote, "I have worked on standard #1 since 1:00 PM or so-Jim Buell dropped in and coached as I started. I then went on to do all YLPs' standard #1. That is, all of those who had entered something for standard #1. It is now 3:30 PM. I have not left my chair, but have had a steady stream of phone calls, visits, and secretarial interruptions. It is my opinion that I can get quite a bit done in a short amount of time if I stay with one standard and do this after hours. ... There are several do-it-again and 3 exemplary judgments. They differ, but should have in common-more than we asked for."

Through these efforts, the instructor completed the evaluation of one of the eighteen competencies for the thirty students who had attempted it, within four weeks of the time the students were introduced to the TCD. However, those thirty submissions were just one-fourth of the 120 which students had submitted up to that point. Owing to other demands on his time, the instructor was able to advance little in the task over the following month. By late November, nearly all students were still waiting for responses to descriptions they had entered as much as two months previously.

Problems to date

As solutions are being found to problems associated with access speed, information collection and usability, a key problem regarding feasibility of use has been discovered. It has become obvious that faculty will have a difficult time providing the optimal level of individualized feedback to students that the TCD is capable of enabling. The success of the TCD initiative will depend upon our discovering several acceptable models for assisting instructors in managing the effort involved in evaluating student submissions. Designers, instructors and users all agree that having one professor evaluate fifty-seven students in eighteen different competency areas is proving to be an unrealistic task.

Future directions

This raises interesting questions about the role of evaluation in a student-centered resource like the TCD. At least one faculty member has considered the idea that students themselves be required to evaluate, or pre-evaluate, one another's completions of the competencies. However, students who have been presented with this idea have responded that they do not believe they would be qualified to judge one another's work. An alternative strategy might be to devote the time of a teaching assistant to this task; this, in fact, was suggested by two students interviewed for this study.

Summary

The convergence of calls for technology competencies and the need for improved assessment motivated the development and implementation of the Technology Competencies Database. We see this as a way to help students acquire a wide range of expertise with educational technologies, while at the same time providing them with the tools to support the students' development of electronic portfolios illustrating their expertise. While we have developed a system that supports students in their submission of evidence supporting their expertise, we still need to develop additional tools to help faculty evaluate these submissions in a timely and efficient manner.

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Appendix: Fall 1997 Student TCD Handout

Introducing the Technology Competencies Database matrix

Recently, the International Society for Technology in Education has drafted several sets of competencies for teachers in training. The first set of 18 competencies, "Foundations," is intended for all undergraduate education students. The National Council for Accreditation of Teacher Education has accepted the ISTE standards as goals for all teachers in training.

As part of your teacher training, you will have ongoing opportunities to assess your level of achievement in these competencies. You will be using the Technology Competencies Database (TCD) matrix, an information-gathering resource that runs on College of Educationís web server. Using web-browsing software, you will be able to correspond with your instructors to describe how you have met various competency requirements, and to seek their approval. The TCD will let you build a personal record of your accomplishments, which may be of great use to you in later job searches and resume-building. The TCD will also help your teachers to lead a course that takes full account of your current knowledge and needs.

The TCD matrix is still in an evaluation phase. Throughout the course, we encourage your comments and suggestions about how to adapt it to suit your needs and interests.

Using the TCD matrix, you will be presented with descriptions of each of the 18 foundation competencies, and will be requested to write online about how you have met any or all of these. Supporting evidence may be given in the form of a URL, pointing toward your own home pages. Instructors will then have the opportunity to evaluate your efforts. Credit may be awarded in the form of a "gold-star" (or, for outstanding efforts, a "double star"); alternatively, you may be asked to revi your descriptions before credit is awarded.

Although you will use web browser software to build your personal matrix of competencies, you should get started with the process by looking over the competencies on the other side of this paper. Check off any competencies which you already have, and jot down a short description of how you have met them. Soon, you will have opportunities to enter this data into the TCD, so your teachers can see your answers and evaluate them.

Here's how to get started using the TCD matrix:

1. On a computer connected to the Internet, start a web browser program (we recommend Netscape 3.0 or higher)
2. Go to the following site: http://lrs.ed.uiuc.edu/tcd/
3. Log in, using your network ID and the TCD password you are given by your teacher (if you would like to use a different password, please tell your teacher; do not select your network password, however - at present, the TCD matrix is less secure than the universityís system)
4. From the matrix (pictured on other side), select a competency to write about.
5. Write about how you have satisfied the competency; give detailed answers, and consider putting evidence onto a personal home page for your teacher and others to see.
6. Submit your answer for your teacher to evaluate; optionally, you may also send e-mail to your teacher.
7. Return to the TCD matrix regularly, to check your progress and to write about additional competencies.

Technology Competencies Matrix for Joe Test

Name: Joe Test Network ID: j-test Educational Program: example

Foundations Competencies

1. Professional studies culminating in the educational computing and technology literacy endorsement prepare candidates to use computers and related technologies in educational settings. All candidates seeking initial certification or endorsements in teacher preparation programs should have opportunities to meet the educational technology foundations standards.

Group Description

1.1 Candidates will use computer systems to run software; to access, generate and manipulate data; and to publish results. They will also evaluate performance of hardware and software components of computer systems and apply basic troubleshooting strategies as needed.

1.1.1. Operate a multimedia computer system with related peripheral devices to successfully install and use a variety of software packages.	
1.1.2. Use terminology related to computers and technology appropriately in written and oral communications.	
1.1.3. Describe and implement basic troubleshooting techniques related to using a multimedia system with related peripheral devices.	
1.1.4. Use imaging devices such as scanners, digital cameras, and/or video cameras with computer systems and software.	
1.1.5. Demonstrate knowledge of uses of computers and technology in business, industry, and society.	

Group Description

1.2 Candidates will apply tools for enhancing their own professional growth and productivity. They will use technology in communicating, collaborating, conducting research, and solving problems. In addition, they will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical, and legal use of computer/technology resources.

1.2.1. Use productivity tools for word processing, database management, and spreadsheet applications.	
1.2.2. Apply productivity tools for creating multimedia presentations.	
1.2.3. Use computer-based technologies including telecommunications to access information and enhance personal and professional productivity.	
1.2.4. Use computers to support problem solving, data collection, information management, communications, presentations, and decision making.	
1.2.5. Demonstrate awareness of resources for adaptive assistive devices for student with special needs.	
1.2.6. Demonstrate knowledge of equity, ethics, legal, and human issues concerning use of computers and technology.	
1.2.7. Identify computer and related technology resources for facilitating lifelong learning and emerging roles of the learner and the educator.	
1.2.8. Observe demonstrations or uses of broadcast instruction, audio/video conferencing, and other distant learning applications.	

Group Description

1.3 Candidates will apply computers and related technologies to support instruction in their grade level and subject areas. They must plan and deliver instructional units that integrate a variety of software, applications, and learning tools. Lessons developed must reflect effective grouping and assessment strategies for diverse populations.

1.3.1. Explore, evaluate, and use computer/technology resources including applications, tools, educational software and associated documentation.	
1.3.2. Describe current instructional principles, research, and appropriate assessment practices as related to the use of computers and technology resources in the curriculum.	
1.3.3. Design, deliver, and assess student learning activities that integrate computer/technology for a variety of student grouping strategies and for diverse student populations.	
1.3.4. Design student learning activities that foster equitable, ethical, and legal use of technology by students.	
1.3.5. Practice responsible, ethical and legal use of technology, information, and software resources.	

Last updated: 1 September 1997 Created by Keith Garrett; updated by Jim Levin, Ed Malczewski and Jim Buell.

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Teach Me To Facilitate Learning ... With A Computer

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Educational reform initiatives aimed at integrating technology into the curriculum are well at work in institutions of higher education across the country, with computers being the technology of choice. As more and more K-12 teachers are required to change their teaching methods and teaching styles to include technology, educators within teacher education programs are being asked to alter their methods and styles of preparing teachers, specifically to include teaching with technology. To facilitate this change and to structure computer-based activities, teacher preparation programs tend to use either the International Society for Technology in Education (ISTE) Foundation standards or the Association for Educational Communications and Technology (AECT) program and learner guidelines. (ISTE, 1997a; ISTE, 1997b; ISTE, 1997c; Wiebe and Taylor, 1997). However, as curriculum strategies are developed to address the issue of educational reform for technology inclusion, a word of caution is in order. Whether the chosen strategy for change consists of an isolated computer course, the concurrent attachment of a computer lab to existing courses, and/or the option to use and model the use of technology in established teacher education courses, what you do not want is for the integration of technology to mimic the training environments of business and industry.

Viva La Difference!

There are many lessons to be learned from business and industry training environments. However, it is crucial to remember that the focus of training in business and industry is short-range instruction for equipping employees with new skills that will be applied immediately once they return to the job. Teacher education programs may have a short-range need to impart basic computing skills to its students. However, the focus of their computer-based activities must go beyond short-range, step-by-step skill development to include long-range transfer of learning and transfer of training. This is necessary because (a) each year, more and more students enter higher education with basic computing skills, (b) the majority of the students will not go immediately to the teaching job, and (c) the steps students are taught to perform computer skills are subject to change over time as software is upgraded. And although the creation of isolated word processing-, spreadsheet-, database-, graphic-, presentation-, and telecommunication-based documents (which is the norm) serve to improve or reinforce basic computing skills, they accomplish little towards preparing teacher education majors for the K-12 classrooms of the 21st century or helping them understand the big picture of instructional computing.

The Big Picture

One of the original arguments for inclusion of computers in educational environments was that "computers increase student engagement, add realism to instruction, promote skill mastery and understanding of principles, augment laboratory experiences, and encourage inferential thinking" (Johnston and Joscelyn, 1989, p. 2). If this is still the case, and many believe it is, then learning through supplemented computer-based instruction is the true goal to which the development of basic computing skills becomes prerequisite for teacher education majors who will ultimately use the computer as both a management tool and an instructional tool. Using the computer as a management tool requires that users develop and demonstrate better problem solving skills, better analytical skills, better critical thinking skills, and better decision making skills. Using the computer as an instructional tool requires the same cognitive skills as using the computer as a management tool, however, such skills must be fine tuned to help develop the corresponding skills within the students being taught. The real challenge is to teach and to reinforce these skills to teacher education majors while simultaneously showing them how to integrate the technology into the range of curriculum they will be teaching.

Preparing For The Challenge

Realizing the challenge before us is not unique to any one institution of higher education, faculty and teaching assistants within the Educational Technology Program at Purdue University began working together on a project to transform the computer labs for two of its highly populated

courses into environments which facilitate more cognitive learning experiences through scenarios-based computing activities. In preparation for the change and to better understand the students in attendance, both courses were to be taught as usual during Fall semester 1997, however, the strategic collection of data was planned as a means of justifying the future changes.

An initial data collection instrument was designed and distributed early in the semester to gather profiles of current students (Appendix A). Approximately 30 days into the semester, a second instrument was distributed to solicit student feedback regarding on-going computer activities and projects (Appendix B). Throughout the semester, the largest populated computer lab was closely monitored by the instructors and the teaching assistants with discussions of problem areas taking place via email correspondence and weekly staff meetings. Approximately 10 weeks into the semester, one learning activity was administered specifically to gather information as to whether or not students were making the integration connection between classroom lectures and computer-based activities (Appendix†C). The final data collection instrument was distributed at the end of the semester to assess the learning experiences of the students. As such, the information provided the foundation for pilot testing the use of scenario-based activities.

Why Scenario-Based Computer Activities

The scenario-based computing activities were designed with a four-fold purpose in mind, specifically to allow

1. faculty to closely correlate the required computer component of the course to learning which takes place through the class lectures and textbook.
2. faculty and the teaching assistants to use instructional computing to teach and reinforce the educational skills which need to be developed, i.e. problem solving, analysis, critical thinking, and decision making.
3. pre-service teachers to use cognitive skills to help them learn about computer use and solve problems related to computer use.
4. pre-service teachers the opportunity to create a living portfolio which contains examples of instructional computing projects they understand and can implement within a curriculum.

Scenario-based computer activities incorporate the day-to-day work situations encountered by in-service teachers with the possibilities of effective computer use. Doing so provides pre-service teachers with an opportunity to focus on (a) the management and instructional duties faced by in-service teachers and (b) technology integration issues within the classroom. It also forces them to think about each task in relation to what they might actually face sometime in the future. The instructions for each scenario-based computer activity solicits questions from the students that are necessary to clarify the situation. Failure to ask questions may result in obstacles for resolving the problem, however, questions are entertained throughout the activity.

Data files are provided for each scenario so that students focus primarily on the task and not on data entry. Additionally, since resolution of each situation could differ from student to student, collaboration is facilitated. Ultimately, each scenario requires that students think about and discuss computer use relative to (a) what needs to be done, (b) why the computer becomes the medium of choice for the specific scenario, and (c) exactly how the computer will be used. Then, and only then, do the students use the computer to perform the necessary management task(s) or instructional task(s).

This curriculum strategy will be demonstrated during the poster session so that attendees can see why it does a better job of preparing teacher education majors to integrate the technology than the basic computing skills method. To experience scenario-based computer learning first hand, interested individuals will have an opportunity to participate in solving the following scenario-based computing activity and brainstorming the development of a new activity.

A Mini Management Scenario-Based Activity

Approximately 876 students attend Smith High School in the urban community of Anytown, Your State. In an attempt to increase school security within the district, the superintendent of schools implemented a picture ID card/ barcode scan system within each high school. Students gain entry into the school by scanning their ID card at the monitor station that simultaneously documents the date and time of entry and departure. Over the past six weeks, the system has worked extremely well Ö so well, that a suggestion was made to eliminate the 20 minute home room period and redistribute that time into the current block scheduling periods. To test such a possibility, each homeroom teacher was asked to match the manual attendance records of their students for a two week period against the computerized records of entry and departure for the same time period. As one of the 47 homeroom teachers, you must verify the records for your students and provide a report of its accuracy to the school principal within the next seven days. The principal is also interested in hearing your thoughts about using the picture ID card/barcode scan system to eliminate homeroom period within the report.

Abbreviated Scenario-Based Activity Instructions

Since each teacher is responsible for accessing the computer database located in the main office and requesting a printout of his/her students for the designated two-week period, five 1/2 hour training sessions were scheduled to

brief teachers on obtaining a computer printout. The training sessions will take place this week on two mornings before home room period and three afternoons following the last class period. You have the option of attending one or more of the session and/or using the self-instruction sheets to learn the system. Feel free to collaborate with other teachers, however, each teacher must submit a typed report no later than 5:00 PM next Friday. It is important for you to remember that the database you will be accessing contains sensitive and confidential information in addition to the full name of each student, complete ID number, full home address and telephone number, complete parental/ guardian information, complete high school schedule for the current school year, and all entry and departure information for the school year thus far. You do not need a printout of every piece of information, just your students and the dates and times of their entry and departure during the designated two week period. Are there any questions?

As such, the completed scenario-based computer activities lend themselves toward preparing pre-service teachers to interact with the realities of their future work environment and prepare themselves accordingly. Pre-service teachers should find that responding to real-world situations is fertile ground for learning, understanding, and reasoning through the process of computer use. And equally important, computer use is no longer a luxury, but a necessity (Thomas & Knezek, 1997)

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TEACHING A TEACHER ABOUT TECHNOLOGY: A NARRATIVE APPROACH

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As computers become prevalent in every part of our daily lives, so does the need for training on how to use those technologies. Because of this increase in need, demands have also been placed on schools to educate our children and make them "technology literate." However, prior to educating our youth, efforts must be dedicated to preparing teachers who can harness the educational possibilities of using computers in the classroom. One of the most difficult tasks any undergraduate teacher preparation program can face is trying to help educators become comfortable with computers while still preparing them for the ever changing and flexible technologies of the 21st century. Over the course of the past five year I have either taught or been a part of numerous teacher technology-training programs in Elementary schools, Middle schools, High schools, and Universities across 2 different countries. Time and time again I am presented with training programs that show teachers how to memorize steps in order to become experts in particular software. The problem is that with the speed of changing technologies, expertise turns into frustration as memorized steps become chaff in the wind. This is readily apparent in undergraduate pre-service programs where students learn technology skills but find that they can't integrate the skills (or can't remember the steps) upon graduation and placement. There are cases where teaching specific skills inspires some teacher education students to adopt a technology mindset to approaching curriculum planning. However, for the most part, this transmission model of technology adoption fails.

A Narrative Solution

Stories have been used to educate since the beginning of time. And recently, there has been a resurgence of interest in a narrative approach to educating our youth by educational researchers (McEwan & Egan, 1995; Heath, 1994; Egan, 1986). McEwan and Egan (1995) introduce their edited book with, "We begin with Barbara Hardy's celebrated observation that we 'dream in narrative, daydream in narrative, remember, anticipate, hope, despair, believe, doubt, plan, revise, criticize, construct, gossip, learn, hate and live by narrative", in order to argue for the importance of narrative in education. In regards to teachers, there has also been an effort to capture their thoughts, feelings, and philosophies through a narrative approach (Jalongo & Isenberg, 1995; Goodson, 1992; Lillard, 1980). Finally, the use of stories has even infiltrated the computer and technology realm (Murray, 1997; Minganti, 1997; Gesture and Narrative Language). What can be learned from the above research is just how important stories can be both as a teaching approach and research methodology in education and educational technology.

In trying to create a pre-service teacher and technology-training program, it is possible to combine the three approaches to narrative. John Shotter points out the following,

> This, I think, is where Wittgenstein's (1953) work is of such importance: for he draws our attention simply to the role in our ordinary, everyday social practices, of us drawing each other's attention to aspects of our own ongoing practices, especially to its crucial role in us learning our social practices in the first place.

Therefore, if we adopted a dialogical or narrative approach as the actual autobiographical teaching method (combining all three of the above uses), we would help the pre-service educator become aware of their own feelings and thoughts about computers and education. This narrative methodology, rather than a completely skill-based program, affords students the ability to understand their own process of coming to know how to integrate changing technologies as a tool in education rather than a fixed landmark based on software instructions. These stories, told by the teacher through the process of learning about technology, would reveal a detailed picture to the researcher, teacher, and student herself of the development process a pre-service

educator goes through on her way to learning how to use technology in the classroom.

Method

In March of 1997, I was approached by a pre-service student who was interested in learning more about technology. She was going to look for a job over the summer and felt like the market demanded technology skills that she did not have. It was about this same time when I became very interested in the narrative approach and so, with her permission, set out on a quest to teach her about technology in a storied manner.

We decided that we would meet as many times as we could prior to her leaving to find a job. I agreed to tutor her but asked if she would be willing to help me learn more about how to teach technology to an audience such as the one she originated from. I informed her that the process would include audiotaped sessions, weekly journals from her, and a beginning and ending interview. However, I also let her know that failing to meet any of these needs would in no way jeopardize her tutoring sessions.

Finding out about technology

We met throughout April and May of that year for about 1 hour to 90 minutes a session. I spent most of the time teaching her how to accomplish certain tasks (e-mail, browsing the web, creating web pages), but left enough details out to reinforce my constant reminders that the process was more important than the details. During those sessions, in order to help both her and me understand the processes she was going through, I asked her to "think aloud" during the sessions. Meaning, I wanted her to talk through whatever she was doing—both the actual mechanics of what she was doing as well as her thoughts about how she would or wouldn't use the technology. I was trying to get her to determine where technology fit into her philosophy of teaching. Initially, she was nudged into doing so by my continually asking questions about what she thought she was learning and how she thought it might impact her teaching. However, as time passed, she became more and more comfortable with the think-alouds. As I reviewed the audiotapes, I was amazed at the shift from the initial tape to the final tape. My voice could be heard through much of the tape in the beginning. However, towards the end of our sessions, one wondered whether I was even in the room. I owe this to the fact that she was becoming more comfortable with technology and more importantly with her story about technology.

Another important component besides the think-alouds was the weekly journals. Three important notions became evident in the journals. First, technology was frustrating to her (as it is to most teachers learning about computers for the first time). Early entries were comprised of: "I still feel pretty overwhelmed about what the possibilities are in the this crazy computer world." and "I found our meeting frustrating..." However, later entries showed a developing sense of learning how to use technology: "I also found a sense of patience that is necessary as I begin learning my way around." and "I'm starting to understand at a more connected level."

Second, the agenda that I had started out with was by definition very loose. I wanted to be able to structure our sessions around initial basics (surfing the web, using e-mail, etc.) but I also wanted to have time to encourage her interests and her thoughts about computers. I found that she not only followed her own interests but started asking her own questions about teaching and teaching with technology. "Our sessions remind me of how haphazard learning can be. If we stuck to the outline we create at the beginning of the session, we'd be missing out on a lot of the discussions we've been having. It can be scary from a teacher perspective to stray from the plan, but do teachers always know the best way to proceed with a subject?" What initially began with, "I am interested in..." turned into "I really want to learn how to create a webpage. We should look at some classroom web pages to see the kinds of things they have on them."

Finally, it became evident through our sessions that she was learning more than just skills, but seemed to be rewriting her story of how she viewed herself in relation to technology. She reported that she moved from being afraid of computers to being willing to try different things out. It is through this process of learning and telling narratives about that learning that the student changed her own narrative on her view of technology and philosophy of teaching.

Implications for Pre-service Education

Although my case study was only an N of 1, I believe that it has some important implications for preparing teachers to be technology literate. First, as with any class, there must be an agenda with objectives of what should be learned. However, if we can move away from skill objectives to focus more on the teacher coming to her own understanding of technology in the form of how it changes her story, we may be teaching them how to use tools rather than just which way to turn a screwdriver. Therefore, successful programs will focus on teacher exploration of their own interests whether that is with a supercomputer or a calculator.

Second, my case study was unique in the sense that I was able to have constant dialogic interaction throughout the learning process. In a classroom of 20 students, that isn't always realistic. However, as we change our pedagogy to focus on the teacher as facilitator of knowledge rather than master of the class, we realize the importance of using classmates in learning objectives. This would include working on technology collaboratively and having one of the partners facilitate think-alouds while the other explores.

Journals can then help communicate between the observed, the observer, and the educator. Journal topics would focus on what the students learned about the other person as well as their own views of technology. Using Shotter and Wittgenstein's ideas mentioned above, students become aware of their own social processes and in turn their own story about technology. As my subject replied, "I, too, would like to have some documentation about my learning process."

Finally, when asked about what makes a technology expert, many students reply that it is the ability to walk into most technology situations and not necessarily know everything that is happening, but not being afraid to try. It is very rare that anyone states a technology expert is someone who knows everything there is to know about "X" software. In the ending interview, the student in my case study reported that she still gets frustrated over not being able to do certain things with technology. However, through discoursing about technology and its relevant uses to her ideas of pedagogy, she has gained a persistent attitude, a willingness to try, and has started to overcome the fear of computers that dominated her earlier story. When teaching pre-service teachers about technology, many programs force students to adopt their story of what technology should be used and how it should be used. In the end, students drop those stories as easily as one forgets a joke. However, we may be able to facilitate the creation of the educator's story through discourse and dialogic interactions about the processes they are going through in learning about that technology. As they go into the workplace, technology is not an add-on but a central component of their philosophy of pedagogy.

Future Research

The findings in this paper are based on preliminary analysis of audiotapes, journals, and interviews with a preservice educator as she learned about computers and how they can be used in her classroom. Future research includes a more complete analysis of the transcripts to not only examine more closely the teacher's story, but also the dialogic interaction between the researcher and the educator. I hope that this analysis will provide more information about how teachers realize and conceptualize technology in their stories as well as how those dialogic interactions could be reproduced in the classroom. Finally, I also hope that this and future research will shed light on more effective ways to teach teachers about technology by using a narrative approach.

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Computer Literacy Through Exploration and Discovery: Integrating Technology Into the Classroom

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The purpose of this technology training model for preservice (those in training) and inservice (practicing) teachers was two-fold in order to address technology integration into the pre-college classroom and preservice teacher education programs. The first purpose was to provide inservice teachers the essential training for integrating technology as an instructional tool. Simultaneously, a model for preservice teacher education instructors was being developed to assist with the integration of technology into the methods courses across the curriculum. The question to be answered was whether technology training should include learning the basics of how to use a computer (e.g. using a wordprocessor or spreadsheet) and then how to integrate specific applications into the content or can both be addressed simultaneously? This paper describes the logistics of the training model designed to investigate the effectiveness of training teachers how to integrate technology based on the constructivist philosophy that learning occurs and is transferred when based on the participant's own exploratory and discovery experiences.

Background

A teacher's decision to implement technology in the classroom is guided by many factors including accessibility to equipment, educational objectives, students' diverse needs, and the teachers' vision and expectations regarding the contribution of the new technology to achieve local, state, and national educational goals and objectives. Researchers during the past decade have provided evidence demonstrating the effectiveness of computer-assisted instruction in the classroom for improving students' ability to learn (Duplass, 1995; Kaput, 1992; Kulik & Kulik, 1987; Liao, 1992; Niemiec & Walberg, 1987; Niemiec & Walberg, 1992; Ryan, 1991). The current curriculum reforms in math, science, language arts, social studies, and technology education in our precollege classrooms have required essential training of preservice and inservice teachers. The integration of technology in the precollege classroom is upon us and as a result, the proper training of teachers must include modeled instruction using technology for teaching specific concepts that can be transferred into the teachers' real classrooms of instruction. Research has shown that technology instruction not linked to subject matter is not valued by the learner (Schmidt, Merkley, Strong, & Thompson, 1994) and this model was developed to address both theory and application simultaneously. In other words, the teachers will learn the logistics of using a computer through applicable, exploratory training that could be transferred into the precollege classroom. Furthermore, the preservice and inservice teachers worked together on interdisciplinary, multiple grade level teams. For example, an elementary preservice teacher was a team partner with an inservice ninth grade science teacher and an elementary preservice teacher was a team partner with a preservice secondary mathematics teacher. Because each of the groups of teachers (preservice and inservice) was currently completing a different phase of their career, the exploratory environment encouraged valuable interactions between the teachers and their learning was complemented by the interdisciplinary teamwork.

It is essential to provide training across the curriculum at the undergraduate level in order to prepare preservice teachers to enter schools with the needed technology training. Similar training is needed at the graduate level to provide training as technology continues to change for inservice teachers returning to complete their graduate work or receiving re-certification. On a national level, technology began as an essential tool in the business world. As changes occur in our society, the curriculum in our schools must also adjust in order to produce students who have the foundation to use computers as problem solving tools as they pursue a college degree and function in the technology-based workforce. Therefore, it becomes a necessity to prepare teachers in all curriculum areas how to use technology as an instructional tool and to know when it is appropriate to use technology to involve students in active use of the computer without inhibiting essential skills such as reading, writing, computing, and communicating.

Given this current emphasis for computer integration into precollege classroom instruction, the concern arises whether the use of computers as an instructional resource should be taught in a separate course or integrated into the current courses in much the same manner as other subjects, such as mathematics, are integrated and taught based on hands-on, exploratory methods supported by the constructivist philosophy. When an educator speaks of integrating technology into the K-12 classroom, the immediate thought is the effect of computers on the "learning" of subject matter. However, who makes the decisions on computer specifications, software purchases, computer layout in a laboratory or classroom, funds for upgrades and expansion as technology changes? Aren't these issues also pertinent to the integration of technology in our schools? The answer is yes. Therefore, there are many ethical and legal issues that must be addressed by the teachers and these issues must become part of producing a computer literate teacher for the 21st Century.

Model for Technology Training

The model described in this paper was designed to incorporate the critical components teachers need to integrate technology into the classroom as an instructional tool for teaching across the curriculum as well as the theory and knowledge needed to support their teaching philosophy. One unique feature of this model was providing interdisciplinary training involving preservice and inservice teachers across grade levels (K-12). Observations indicated that the pairing of the inservice and preservice teachers across subject areas was one of the most valuable aspects of the computer training model. Eleven teachers (6 preservice and 5 inservice teachers) participated during the first year pilot study and twenty-six teachers (12 preservice and 14 inservice teachers) participated during the second year of implementation of the revised training model.

Description of the Interdisciplinary Experience

The planning of the computer training model began through a grant from the Mississippi State Department of Education. A pilot of the model was planned during a five-week period of the summer of 1996 based on input from an advisory committee consisting of teachers and administrators from the public schools. The goal for the model was to provide preservice and inservice teachers the opportunity to work together on exploring, discovering, and communicating how technology should be integrated in a practical way into the curriculum. An emphasis was placed on fitting technology to the curriculum already present in the school as opposed to fitting the curriculum to the technology (Niess, 1990). Based on the feedback from the eleven teachers, the model was revised and implemented again during the summer of 1997. One of the major revisions was the time period for the training. All of the teachers recommended that the training be extended over a long period of time because they did not feel enough time was allowed for exploration, reflection, project expansion, or discussion during the five week period. During the second summer, the model was implemented in a 10-week period and this adjustment was sufficient time for the teachers to reflect on their work and apply the learning theories discussed in class. The objectives of the training model were for the teachers to:

1. Identify current issues in mathematics, science, social studies, language arts, physical education, and foreign language that affect the selection and use of technology,
2. Plan lessons and design instructional activities that integrate technology using a direct and constructivist learning strategy based on state and national curriculum standards,
3. Apply appropriate use of specific kinds of instructional software and technology using either a single subject or an interdisciplinary approach,
4. Match specific kinds of instructional software and technology tools to classroom needs and design a computer-based laboratory and classroom, and
5. Identify appropriate funding sources and prepare a proposal for obtaining and using technology resources in the classroom and persuade others of the validity of their ideas.

The importance of creating this model was to provide teachers across different grade levels (K-12) and subject matter the opportunity to receive technology training that could be transferred across the curriculum and determine the effectiveness of technology training designed to teach both theory and application simultaneously. If teachers are expected to provide their students a problem-solving environment in the classroom, teachers must feel confident in their ability to use computer applications as tools for solving problems. Therefore, it was essential to train teachers as we would want them to integrate technology into the precollege classroom through hands-on exploratory and discovery-based projects that were supported by the constructivist philosophy for teaching. As a result, the teachers explored and discovered for themselves and were forced to acquire any basic computer skills that they did not have prior to the training experience. Throughout the training sessions, the instructor modeled how to provide students the opportunity to explore and discover through interdisciplinary lessons taught using appropriate technology-based ideas. As follow-up, practical applications that the teachers could transfer into their classrooms were assigned as projects. It was the combination of the projects that provided a valuable technology training model that could be used by any individual desiring to learn how to integrate technology into the classroom as an instructional supplement. A summary of each project is provided below:

1. Experimental and observational projects

The teachers gathered data from experimental and observational projects and used appropriate computer applications to analyze the data, interpret and communicate the results. There were a series of these projects for different disciplines. An example of one group's experimental project was to study the effect of the height and slope of an incline on a toy car's speed. They ran 20 independent trials, recorded their data, and used the spreadsheet to produce line graphs. Then, they hypothesized what would happen if the slope and/or height was increased. A whole group discussion of how and why the graph changed was initiated and the teachers concluded by brainstorming how they could expand this activity and apply the same concepts in other subjects. Many more of the teachers' ideas surfaced because of the discussion than would have occurred if the teachers had not explored and discovered for themselves. After each group had presented, a whole group discussion was necessary to summarize how the lesson "fit" the curriculum objectives. Finally, the groups exchanged lesson plans.

2. Layout of computer-based classroom and laboratory

The teachers designed a computer-based classroom and laboratory layouts with a minimum amount of technology resources and the typical classroom features: 5 computers, 1 television, sitting for 30 students (they chose whether tables or desks), 1 blackboard, and 1 teacher's desk. The layouts were produced using drawing software of their choice. A written explanation accompanying the layout included cost, justification for classroom layout, and uses of the computer-based classroom. A majority of the teachers placed the computers on tables and located them separate from the students' desk. Their explanation was that it was important to not only teach students by using the computer, but to emphasis to the students the importance of knowing when it is appropriate to use technology. Therefore, they did not want the computers on the students' desks at all times for their convenience. This was an indication that the teachers were beginning to transferring from the training their own philosophy of how to "fit" technology into their already existing curriculum and their own philosophy of teaching.

3. Mini-grant proposals

It is essential for all teachers to remain current with the ever-changing demands by providing them with the grant writing skills needed to continually update the resources in their classroom as technology continues to improve. The teachers wrote a mini-grant for supporting a technology-based classroom.

4. Interdisciplinary instructional modules created by teams of students

Using state and national curriculum objectives, the teachers developed single subject and interdisciplinary computer-based activities. These activities preceded the teachers' interdisciplinary, multimedia lesson modules that were presented to the class.

5. Development of a technology plan

The teachers located outstanding schools' technology plans from across the nation in preparation for developing their own technology plan given criteria and including state-of-the-art technology. The research component included interviews of teachers at different grade levels (in person or via the Internet) and administrators.

6. Persuasive presentation

The teachers prepared a PowerPoint presentation to address the following scenario: Suppose your school has $10K to spend. Prepare a persuasive argument to convince your colleagues and the parents that the money should be spent on technology for the classrooms in the school. Provide specific examples, cost, logistics, and computer specifications required for ordering. The purpose of this project was to assist the teachers with their communication of technology issues as they prepared to return to their schools and use technology as an instructional and training instrument. One important aspect was to build their confidence in their ability to first, use technology in front of a group, and secondly, be able to correctly "talk" the language.

Results and Conclusions

Based on the teachers' evaluations of the experience, they received valuable experiences and felt confident returning to their classrooms and implementing similar projects with their students. The overall rating of the experience by the 26 teachers was 4.8 out of 5.0. A random selection of fourteen of the teachers was made and telephone interviews were conducted as preliminary data as to whether the teachers have begun to implement the skills they learned. All of the teachers were able to describe at least one application they had implemented thus far. A content analysis was conducted on the teachers' implementation responses and those could be summarized by the five categories shown in Table 1 (the teachers could give more than one response).

The follow-up interviews indicated that the teachers were transferring the technology skills learned in the workshop into their classroom. The most impressive result was that 13 of the 14 teachers responded that they were taking the initiative to explore and discover how to use the computer applications discussed during the training session. This response prompted a second question as to why they felt their exploration was necessary after having just completed the ten- week training session. Overall, the

teachers responded that either they wanted to learn because they had acquired just enough of the basics to give them confidence to continue, or they were integrating technology-based lessons into their curriculum and working with the students as they explored and completed their assignments. When asked if it had been necessary to teach the students "how" to use the computer prior to giving an assignment, all of the teachers responded "no" because the students could learn the basic skills as they completed their assignments.

Table 1. Content Analysis of Fourteen Teachers' Follow-up Interviews

Response Category	Frequency
Using spreadsheets as a gradebook	10 (72%)
Writing a mini-grant for supplying or upgrading their class computers	3 (21%)
Students using the World Wide Web for research	12 (86%)
Conducting professional development technology workshops in their school	11 (79%)
Exploring in more detail the applications from the workshop	13 (93%)

These preliminary results indicated that technology training designed to address theory and application simultaneously can be an effective approach for preparing teachers to return to their classrooms and actually implement the computer skills learned and provide students the opportunity to explore and use technology appropriately. Furthermore, the teachers were comfortable talking about their ability to "fit" technology into their already existing curriculum. They did not consider the use of technology as a "burden" or something that was required above and beyond their normal lesson planning. In summary, the teachers were trained to learn the logistics of using a computer as an instructional tool through applicable, exploratory training and they were transferring that same constructivist philosophy into their classrooms with their students. The tracking of these teachers will continue and include follow-up surveys, interviews, and classroom visits in an effort to determine in more detail their philosophy on integrating technology into the classroom and how they continue to expand on their lesson ideas for using technology as an instructional tool.

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Co-constructing Practices of Teaching with Technology: Working Collaboratively with TE Instructors on Technology Adoption

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Current conceptions of technology literacy or competency tend to argue for a functional view of proficiency (ISTE, NCATE, etc.) These standards often consist of a laundry list of functional skills that teachers are required to demonstrate before they are judged to be competent with technology. While these standards have helped teacher preparation programs develop assessment programs that measure specific functional skills and expertise, they are often disconnected from the context in which technology serves a useful pedagogical purpose.

Teachers who pass these functional competency requirements can be said to exhibit simple or functional skills associated with a variety of technologies, but there is no guarantee that these same teachers will use technology in pedagogically appropriate or meaningful ways when they encounter these technologies in their own classroom. What represents a more appropriate target for future teachers is some demonstration of adaptive or pedagogical uses of technology within a specific subject area, which I believe requires thoughtful consideration of pedagogical choices in the context of actual classroom practice.

The MSU college of education has been struggling with this issue and recently a group of faculty members and graduate students have been experimenting with a program to implement a stronger pedagogical focus for technology in the teacher education (TE) program - i.e., integration of technology into teaching across the teacher preparation program. To this end, we have been examining the nature of teacher preparation in support of technology adoption, and learning from our own experiences trying to facilitate and support these efforts in the past.

In this paper I will report on some of our initial findings on these and related issues in an attempt to offer alternative ways of conceptualizing teacher technology competencies that hopefully will result in more meaningful uses of technology by K-12 teachers when they have access to technology in their own classroom.

History of the MSU approach

MSU has developed and implemented a variety of support mechanisms to help graduates of their teacher preparation program meet the state requirement for technology competency. The state of Michigan requires that all student teachers be competent with technology, so MSU has an obligation to ensure that its' students meet these legal requirements. In the past, the college of education has taken steps to infuse technology into the teacher education program, including hiring graduate students to teach specific technology workshops, developing technology requirements resources for students, and discussing the integration of technology within the TE program. But it is safe to say that these efforts have met with only limited success in the past and the reasons why illuminate some of the problematic aspects of a functional approach to technology literacy.

Initially, technology education was to occur within two hours of class time each week and were to be provided by faculty or staff from each TE team. This made the goal of embedding technology in curricular contexts very difficult and resulted in a focus on of a small set of generic tools which could be used in a variety of educational settings instead of a contextual technology use approach.

As a result of these constraints, very little attention was paid to curricular-specific technology. A change in focus also occurred when necessary funding for faculty training and support was not forthcoming in the second year of the program. This led to a perception within the teacher preparation program, both on the part of faculty and students, of technology as an additional task and not an integral part of learning to teach. This was reinforced by providing technology classes that focused on functional skill development towards meeting the technology requirements.

Later, technology coaches (also called mentors) were hired by the college to support students learning to use technology and to assess their technological proficiency in five areas: e-mail, Internet, word processing and presentations, database and spreadsheet, and subject-area software.

To understand why these perceptions became prevalent, we need to examine the nature of learning from a specific theoretical perspective, as well as question our own assumptions about TE students and technology.

Theoretical perspective

I hold a social constructivist perspective on learning which argues that learning occurs through participation in social interaction. This perspective stresses the importance of social interaction as providing opportunities for individuals to share their ideas through language, observe and critically review other ideas, and develop a shared sense of understanding within a supportive social context. Within this perspective, instructors, faculty members, and students are all viewed as adult learners who make sense of their experiences through their own beliefs and ways of knowing. These individuals bring their own assumptions about and experiences with technology to their learning and my focus is on helping them co-construct new teaching practices with technology.

I believe our eventual goal is to develop a TE program where technology is seen as a necessary and integral part of learning to teach by respecting the knowledge and expertise the TE instructors bring to their work. This is accomplished by developing collaborative relationship with TE instructors, working together with them on problems or ideas of interest, and engaging in stimulating conversations about technology in a variety of settings. The essential component here is to provide support in the form of ongoing collaborative work that draws on examples of technology use in TE programs and helps instructors see what these methods might look like. Exposure to and discussion about these kinds of experiences which are contextualized in classroom practice might help their students see the connections between their subject areas and possible uses of technology.

Supporting TE instructors in their thinking, talking, and teaching with technology is initially more difficult and less productive (in the short term) than alternative methods but we believe will eventually leading to a fundamental change in the TE program. This collaboration recognizes the interdependence between the TE instructor and the techguide and respects the knowledge that both bring to the relationship. The techguide brings extensive technology experience, having thought about how technology might be supportive of educational goals, and the TE instructor brings practical classroom teaching experience as well as pedagogical and subject matter knowledge. Together, the TE instructor and the techguide form a team that is bigger than either one individually.

Field Experiences with TE Instructors

Deb Smith: Secondary Science TE401 - E-mail and spreadsheets

Deb and I met in a Macintosh lab a few days before she was going to be demonstrating how to use e-mail to send attachments for her TE401 students. We sat down and went through each of the steps as I helped guide her. She also wrote down the steps to document the process for her own students. As a result of that session, Deb felt confident that she could demonstrate for her students how to use e-mail as part of her regular class communications. She planned to use e-mail as a tool for communicating with her students, for encouraging them to share amongst themselves, and for sending her required coursework for grading.

As luck would have it, when she held her class in the very same Macintosh lab, we had nothing but technical trouble from the start. Somehow, the version of e-mail program we had used had been removed from the LAN server and I spent 20-minutes hunting down another copy. When I found it, we scrambled to update the descriptions only to find out that the version we were now using wouldn't work on the computers. I spent another 15-minutes tracking down another version of the software before calling in another faculty member to help us with this problem.

Although we had lots of problems using technology, and the unforeseen problems, Deb kept a good attitude about the whole experience and managed to make the best of a bad situation. I think this experience actually helped her students realize that technology doesn't always work the way we expect it to, a valuable lesson in itself. Deb was able to use the same Mac lab later in the term for a spreadsheet demonstration that went much better. Afterwards, she wrote about her teaching experiences in an e-mail she sent to me:

> "There were the usual server crashes, disk problems, etc. — mostly because when we made the Eudora disks originally, Yong came in and used his account, remember? So, many of their disks apparently had Yong's email address on them, and when they tried to sign on, of course the machine wanted his password. But we got that straightened out, with Deepak's and Tim Smith's help, and several other TEC guides who came over for short periods of time to help us.
>
> I think the seniors were intrigued by the possibilities that Clarisworks showed them for spreadsheet representations, and played around a lot of different graphs and charts. And my in box is full of email and attachments from them today, so I'd say that they all accomplished getting that checked off! :)
>
> Thanks for your continuing support and help, both in helping me learn new things and in making it possible for my students to do the same."

You can see from this e-mail that Deb is feeling more comfortable with technology herself, is especially grateful for the support she gets from the technology guides, feels she has learned a lot, and is also confident she is helping her students learned and meet the technology requirements. Deb

successfully modeled pedagogical uses of technology for her TE students, including dealing with the uncertainties often associated with classroom technology use, and is part of an ongoing discussion about the practical value of technology in Science teaching.

Lynn Brice: Elementary Social Studies TE401: Collecting Primary Sources in a DBMS [URL=http://rorschach.educ.msu.edu/TechReq/TE401_9/]

Lynn Brice and Tim Smith developed a database assignment for Lynn's TE401 class (Section 9, Fall 1997) where their students helped construct a database to organize their annotated bibliographies of useful social studies references. Rodney Williams and myself worked with Lynn and Tim on this project, supporting them before, during, and after their students met in a Macintosh lab as part of their regular class time.

The social studies references were collected from a variety of sources, including books and the World Wide Web (Web), and gathered into a single database for distribution to all students in class. The students met in a Macintosh lab and learned about databases, designed the database for their annotated references, and used the Web to locate potential references.

Tim created a document describing databases and how to create them in ClarisWorks 4.0. Lynn used this assignment to help her students satisfy the database technology requirement (simple or fundamental use) as well as optionally to satisfy the e-mail and Web requirement (simple or fundamental use). Students could e-mail their Web bookmarks or database entries to Lynn or Tim, satisfying the e-mail requirement as well as the Web requirement. Before Lynn brought her students to the computer lab, she wrote about her own plans for using technology, sharing her pedagogical rationale for the assignment and her perspective on the use of technology in her teaching:

> "Thank you for all your help on getting this arranged. I have e-mailed Rodney about what we (Tim Smith and I) have planned for Friday. Tim is going to walk the group through using the database on Clarisworks. We plan on setting up the fields on Friday and then having the students enter on diskettes their three sources to the database. Tim has it figured out how this will work. We were thinking that the students could send their formatted database entries to me as e-mail attachments and then I can cut and paste the database (and Tim will do the same) Then, we will give each student the full database on diskette. We should have a little under 100 entries.
>
> The second half of our time on Friday, I would like to have students look at one or two websites that are from bookmarks I have. I would like to briefly look at two of these sites together and then have the students do some browsing for their unit topics. I think it will be immensely helpful to have you and Rodney there to help them learn to make bookmarks and how to store them on disk. At least get them started on the bookmark tech requirement and get them started on researching their unit topics.
>
> WE are meeting Wed after class. Tim will be there around 12:30-1:00. We typically meet over at XRoads and then head over to the tech lab. I'll look for you to see if you and/or Rodney can join us. I just want to say thanks again. It is a little overwhelming at first to think about how to make this technology stuff happen when, basically, I don't know much more than my students. It is immensely helpful to have Tim, Rodney, and you coaching me as well as the students. I also like having both of you there so our students know you and know who they can go to have their tech requirements checked off independent of 401."

Lynn later shared her own beliefs about how important it is to connect technology use to subject matter concerns:

> "Using these in 301 is OK with me. But I do have one thought. My intention for the technology things we've done is to have them tied closely to the subject matter. As this was my first go around with these particular activities, next time will be refined in that direction. Although these assignments are pretty generic, I do have several other that are specific to social studies and don't think they would be easily used in 301 (for example using spreadsheet to convert historic prices to contemporary equivalents- which I did not do this semester). My thought is that were I to teach 401 or 402 again, I would want to reserve these technology assignments for my syllabus, having put in the time and all to design and incorporate them. Does that make sense? I get the feeling that the most difficult requirements to accomplish get left for 402. I would be unhappy if I were teaching for 402, had these activities ready to go, know how to do them, and then find they were already done in 301. This is not really about using the ones we did on Friday in 301. I think as the program develops these things will be pre-determined for instructors maybe. In any case, I have no problem with passing them along. But you might also want to ask Tim Smith about the data base one because much of it was his design."

You can see from her e-mail that Lynn articulates her beliefs about how the TE program itself should change to support better technology integration across sections of TE courses. This is a good example of how technology is

viewed by her in the service of some larger pedagogical goal. In this case, Lynn is conceptualizing a spreadsheet as a tool for "convert(ing) historic prices to contemporary equivalents," a pedagogically useful way of using technology.

Conclusion

Based on this work, and related research within the MSU college of education, we are moving towards a new goal for teacher preparation at MSU: helping future teachers develop the necessary expertise, dispositions, and attitudes to support their own generative learning around and with technology, and learn to use technology appropriately to serve some useful pedagogical end. In order to understand this process, we need to critically examine our own teaching practices and the assumptions we make about the nature of learning, teaching, and the role of technology.

I believe that building collaborative relationships with TE instructors, respecting the knowledge and expertise they bring to these interactions, and supporting their efforts to construct their own practices of teaching with technology will ultimately result in the fundamental changes described above. There is no doubt that this change will be difficult and time consuming, but this approach is also consistent with social constructivist views of learning that I hold which shape my own understandings of the intersection of technology and teaching in the work I do with staff at the college of education.

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WEB-BASED DISCUSSIONS: BUILDING EFFECTIVE ELECTRONIC COMMUNITIES FOR PRESERVICE TECHNOLOGY EDUCATION

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According to Turkle (1995), "In cyberspace, we can talk, exchange ideas, and assume personae of our own creation.We have the opportunity to build new kinds of communities." Technology and teacher education at the University of Virginia's Curry School of Education has included programs such as the Technology Infusion Project (TIP), which promotes collaboration and communication between preservice and practicing teachers in area classrooms. Advances in technology have provided the impetus for exploring additional modes for increasing communication among preservice teachers. As is the case in many educational technology classes at other schools of education, electronic communication initially centered around the use of electronic mail. Every preservice teacher has access to a university e-mail account for communicating with other students and instructors. For the most part, e-mail has increased communication, however, this has been limited to interactions mainly between students and the instructors. Although students were encouraged to communicate with one another to share ideas and ask questions, few took advantage of this resource.

To increase the level of interactivity among peers, students were required to participate in weekly electronic newsgroup discussions, with the hope that these "discussions" would encourage class members to engage in thought-provoking dialogue. More often than not, student responses to the newsgroup resembled individual "reaction papers," rather than ongoing discussions of issues and perspectives. Although students found e-mail helpful in communicating with instructors outside of class, most found class discussion on the discussion group time consuming, and of little worth.

The gaining popularity of the World Wide Web has provided us with some solutions. What has evolved is a unique system for learning about various educational technologies and their professional implications through Web-based collaboration and communication with like-minded peers and professionals. This system, Curry CONNECT, enables the type of electronic communication that is essential for providing successful technical and instructional support, facilitating discussions of current and relevant topics about technology in schools, and fostering the development of a emergent professional community whose members are comfortable with incorporating innovative uses of technology in their teaching practices.

Through the CONNECT site, our goal is to create an environment for open communication on topics of common interest for the students involved in a number of educational technology courses. By creating a virtual community we are opening the lines for collaborative learning (McQuail, 1995) so that large numbers of students and instructors are able to discuss issues without the normal constraints of time and place (Cutler, 1996).

This new medium for class discussion has the potential to change the definition of social roles and lift constraints on the current order of the situation. The ability for a number of participants to read and respond simultaneously establishes a forum in which every participant has an equal opportunity to be heard (Rosenberg, 1992). One of the greatest challenges to overcome in completing this task it to ensure that students are prepared to use the technology. While the opportunity is present for all members of the group to have an equal voice in the discussion, this cannot occur if they lack the technological knowledge to perform the operations required to submit their own contributions.

The technology currently used is primarily Web-based, due to its familiarity and accessibility among students in the current class. Students access this "central" location for core materials, such as the course syllabi, school maps, educational Web sites of relevance to the week's topic, and on-line forms for filling out weekly progress reports. Resources, readings, and threaded discussions are also linked into the site. This concentration of activity served as a first step toward establishing an on-line class community. While creating a virtual class space was simple enough, we were more concerned with ensuring sustainability. What follows is a discussion of the critical elements we believe are necessary for supporting electronic communities.

Sustaining Effective Electronic Communities of Discourse

Relying heavily on student feedback, we are now able to offer a better understanding of what constitutes effective and ineffective uses of electronic discussions. This feedback has informed the assumptions upon which the suggestions offered in this section are predicated. One such assumption is the importance of a group of like-minded peers and professionals, and the role such like-mindedness plays in the formation of an on-line community. A recognition of the concept of community with which we are working is essential to an understanding of our notion of successful web-based discourse and, therefore, must lead this discussion.

When a group of like-minded individuals gathers to share resources and to strive toward a common good, a community is said to exist (Dewey, 1927). Web-based discussions that succeed are the direct result of a concerted effort put forth by members of such communities. This effort is most often provided thorough the amount of meaning and thoughtfulness embedded in individuals' participation in the discussions, themselves. It has been our experience that, without proper attention to the importance of community, student participation more resembles individual "reaction papers," rather than carefully considered discussions of issues and perspectives. Therefore, fostering a strong sense of community among discussion participants is essential to success.

Effective electronic communities of discourse occur when three fundamental realms of consideration are adequately addressed. First, the intended consequences of the discussion must be explicit and generally agreed upon by those involved. Second, discussion designers and facilitators must be cognizant of the essential attributes of effective on-line discourse. Finally, careful regard must be given to the facilitative structures requisite for sustenance and appropriate progress of the discussion. These realms of consideration are discussed more thoroughly in this section.

Intended consequences

People often view new processes, tools or ideas in terms of solving old problems before learning that, while these new technologies may make the old problems irrelevant, new problems or issues often emerge (Kay, 1992). For example, a typical on-line discourse model involves a conversation between people discussing common issues that begins face-to-face and is then continued via an electronic medium. This model has time and again exhibited an initial stage of general optimism about the successful continuation of the discussion, followed by an overwhelming lack of response and conversation continuity. Similar patterns of response historically have existed among preservice students in technology and teacher education courses. Little attention has been given to the intended consequences — that is, the constructs which emerge from pedagogical and cognitive considerations that directly impact those who are participating in the discussion.

The same can be said of web-based discussions and their use in teaching education. Being cognizant of the intended consequences means recognizing the need to get to the essence of what we want to accomplish. To achieve this recognition requires an analysis of the pedagogical effects enabled by the technology and of the cognitive residue which occurs as a result of the participant interactions. Success is more likely when both participants and instructors are aware of and agree upon the intended consequences they desire the web-based discussion to produce.

Attributes

The most obvious fallacy associated with web-based discussions lies in the assumption that discourse via the Web is really the same as discourse as it occurs in a classroom. It is not. There exist unique attributes associated with web-based discussions which enable certain communicative endeavors and hinder others. An understanding of these inherent characteristics is essential. Successful implementation hinges upon how well the following attributes of on-line discourse are addressed: (1) convenience; (2) familiarity; (3) accessibility; (4) meaningfulness; and (5) focus.

Convenience suggests that unnecessary barriers to usability and understanding are avoided. The principle of familiarity requires that the discussion group incorporate as many common symbols and metaphors as possible. In fact, these two attributes guided the decision toward web-based discussion groups and away from newsgroups. Again, relying on student evaluation and feedback, newsgroups have proven ineffective due to the cumbersome nature of the still-developing newsreaders and to the unfamiliar nature of the metaphors employed. Accessibility refers to the availability of the technologies and resources necessary to fully participate in the discussion. Web browsers are becoming increasingly available and are commonly found on most computer lab machines, which makes web-based discussions more accessible than those relying on platform-specific or proprietary software. Convenience, familiarity, and accessibility are meaningless if they do not combine to enable meaningful communication that would otherwise be inaccessible. Face-to-face discourse among members of a community is spatially and temporally bound. Web-based discussions allow members to extend the parameters and continue discourse in a meaningful manner. Finally, the most contentious and potentially problematic attribute which requires attention is focus. In this sense, the conversations which occur within a Web-based environment must be focused predominantly on the dialogue content, and not on the technology that makes such dialogue possible.

As a result of these considerations, we have adopted a model that strives for a state of "transparency," in which a

blending of technology and professional practice context-building create a more efficacious environment in which the problem of participation is largely dissipated. Telephone use serves as one example of such a model. One rarely gives a second thought to picking up a receiver, dialing a number, and speaking to a person in the next building, state, or country when the need to talk with that individual is felt. We use the telephone, when appropriate, because it is convenient, accessible, we are familiar with it's operation, and - most importantly - it enables meaningful communication which would otherwise be inaccessible. Like the telephone, effective Web-based communication is such when the technology is used in a natural, transparent manner that maintains focus more on the dialogue content between students and less on technological methods that make such dialogue possible. The format of class discussions in this arena have been restructured to reflect this understanding.

Facilitative Structures

Simply creating a discussion area, however, is not sufficient. Sustained dialogue is predicated upon certain facilitative structures. These structures may be grouped according to environmental, social, motivational and expectance factors.

Environmental conditions

Environmental structures include factors that enable a comfortable and successful atmosphere for on-line communication. For example, successful discussions are always grounded in areas of professional relevance — in this case, to preservice educators. To facilitate this, instructors pose "talk topics" around which conversations begin. Examples of such topics have been: "The Computer Delusion" (Oppenheimer, 1997), "Acceptable Use Policies," "Technology Standards," and "Technology and Equity." These talk topics encourage participants strive for depth as opposed to breadth of topics (only four topics per semester are introduced). Also, creating an environment where students can relate personal experiences to the issues at hand is essential. Such an environment encourages buy-in and a higher level of participant ownership in the medium. Finally, the availability of adequate technical support is always a mitigating factor in the success of any on-line endeavor.

Social factors

Social structures are integral to success, and refer to factors that encourage collegiality and meaningful interaction between peers within the group. Our most successful web-based conversations are the ones in which we employ a "moderator" whose responsibilities include responding to students' comments and questions, as well as raising provocative issues for further discussion when needed. For example, Curry Connect combines students from four separate classes to participate in four discussions throughout the semester. Therefore, each instructor takes a turn as moderator for one discussion.

We have found our greatest success when we employ what we refer to as the "Cocktail Party" metaphor. It is essential to note here that we do not view a discussion as a singular event — that is, we do not assume that each discussion group is a simply one conversation in which all participants are equally engaged in all strands. Rather, we recognize that each discussion group is actually comprised of several mini-discussions, all occurring simultaneously. Each mini-discussion is represented by a particular strand or thread in the discussion group, similar to the pockets of conversation which naturally occur at any social gathering where relatively large groups gather. Therefore, much like the hostess at a cocktail party, the moderator's job is to circulate among the various threads and "stir up the pot" or ask and answer questions when necessary.

Motivational issues

Motivational structures involve those factors that address the issues of control and ownership. For many, these structures provide the most difficult barrier to initiating successful web-based discourse. Questions which often arise with this factor are: Are discussions graded/compulsory? If so, how are they assessed? The answers to these questions will dictate who is perceived to be in control of the discussion group, and will have a definite impact on the quality of the participation of those involved. For example, compulsory participation ("You must post two times each week.") obviously places the instructor in control, whereas participation which is not mandatory ("You are encouraged to participate on-line; however, you may hand in a word-processed analysis instead.") allows for a more negotiated sense of dominion. In addition, these issues lead to the question of ownership — another factor which must be explicit and decided beforehand. Those discussions which are highly controlled by the instructor are also perceived as "owned" by the instructor. However, those discussions that are allowed to evolve more naturally — where the instructor is viewed as an equal member of the community — generally result in a higher sense of participant ownership.

Expectations

Finally, expectation structures involve those factors that address the issues of outcomes and demands. Successful web-based discussions suggest that the more explicit these structures are, the more comfortable the participants will be. For example, the instructor's expectations of the quality of the discussion postings must be clear from the beginning. If, for example, participants will be held to some type of standard of discussion quality, that standard must be explicitly shared at the outset. In addition, students must understand and be comfortable with the facilitation role the instructor chooses to adopt. The importance of this comfort level is heightened when the nature of the on-line medium brings focus to those students who may have an inordinate

fear of the technology or of communicating in a public way. It has been our experience that technological fears are more easily mediated. However, there is no worse feeling than crafting a discussion response, offering it to the group, and receiving a deafening lack of replies. In this sense, the facilitative role of the instructor must clearly guide him or her to seek out these situations and quickly provide a reaction.

Conclusion

Recognizing the important role each of the fundamental realms of successful web-based discussions plays will likely increase the probability that your discussion group will succeed, as well. Intended consequences, essential attributes, and facilitative structures are all essential, and combine to create an environment where meaningful and satisfying discourse between groups of like-minded peers can not only occur, but also have distinct educational value.

We realize that relying on technology is not always the best solution and affirm the importance of maintaining personal relationships; however, we also believe that in some circumstances it is desirable to develop electronic communities which further enrich students' experiences and opportunities to grow.

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Training Preservice Teachers in Technology: A Portfolio Approach

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Beginning teachers are often ill prepared for the varied applications of technology in their classroom. The Teacher Technology Portfolio Program is a unique preservice program that combines the infusion of technology throughout the curriculum with the development of a reflective portfolio on technology in education. The program was initially tested with student teachers. Subsequently, every student in the department was required to begin a portfolio to be completed by the end of their student teaching semester. Based on initial evaluation results, a long range plan for continued revision and implementation of the project, training and support for faculty, and acquisition of necessary materials was developed.

Introduction and Background

It is apparent in the field of education that the preparation of teachers to effectively use and apply technology is lacking. Many local, state and national agencies have indicated a need for teachers, both at the preservice and inservice levels, who are better prepared in the area of technology (Lee, 1996; Northrup & Little, 1996; U.S. Congress, 1995). This viewpoint has been supported by accrediting agencies such as the National Council for the Accreditation of Teacher Education (NCATE) which has implemented new guidelines for teacher preparation including standards for technology (Thomas, 1994). There is continued discussion in the field on the best method for preparing teachers, such as using stand alone courses on technology versus the integration of technology into education courses, using a constructivist perspective versus a behaviorist perspective, or incorporating experiences in student teaching or clinical settings (Bosch & Cardinale, 1993; Thurston, Secaras, & Levin, 1996; White, 1995; Willis & Mehlinger, 1996). The Teacher Technology Portfolio Program was developed in response to these issues raised by cooperating satellite school districts, department graduates, students, and the field of education about teacher preparation and competence with technology.

Elmhurst College is a small, 4-year liberal arts college in the Chicago land area. The Department of Education includes programs in Early Childhood Education, Elementary Education, Secondary Education and Special Education. The Teacher Technology Portfolio Program integrates instruction on technology and modeling of instruction with technology throughout the course work in each of the teacher training programs. Preservice teachers begin their portfolios in their introductory courses or their first education course in the department with opportunities in methods courses to build technological competence; investigate curriculum and technology connections; and develop and implement activities that integrate technology. The Teacher Technology Portfolios are finalized during the professional, student teaching semester.

Development of the Program

Initially, faculty in the Department of Education determined the need for a method of infusing instruction on technology throughout the major courses. The idea of using a portfolio approach that would reflect a student's growth in knowledge and application of technology was proposed and approved. A three person departmental committee was formed to develop and monitor initial implementation of a portfolio approach.

Input requested from several departmental advisory councils, composed of administrators and teachers from surrounding local districts, indicated a strong need for new teachers, as well as veteran teachers, to have both basic and advanced technological competence and the ability to apply that competence in the classroom. Based on this input, the technology committee decided to survey students, assess their current knowledge, and then plan a course of action.

Using the text, Instructional Media Technologies for Learning (Heinich, Molenda, & Russell, 1989), the technology committee formulated a survey which was administered to both those students just entering the department's sequence of courses and those students about to student teach. (That text has since been revised and a 5th edition, 1996, is available). Students were asked to rate their skill proficiency in each of a number of areas by indicating previous acquisition of the task, ability to learn the task in the current clinical setting, or the need for an

opportunity to learn the task on campus. The survey was strictly competency based and did not ask the students to assess their ability to integrate their technological competence into the curriculum.

At this time, guidelines for the portfolio were developed. Portfolio requirements included the development of a reflective statement regarding technology and education, the development and implementation of lesson and unit plans with artifacts integrating technology, and the documentation of mastery of basic and advanced competencies with a variety of instructional technologies. Using the results of the survey a list of basic and advanced competencies, as well as forms for documenting the acquisition of the competencies, were formulated and included. Also at this time, an advisory council specific to the Teacher Technology Portfolio Program was formed with the specific function of providing evaluative feedback and advice for the continued implementation of the program. The council is comprised of members of the college community, department alumni, students, and practitioners.

Time lines were also developed for an initial pilot test of the program in the spring of 1996 with students entering their professional student teaching semester. A series of on campus workshops were planned using the data from the survey to support the student teachers in their attempts to build competencies and complete the portfolio. Workshops were planned primarily in areas relating to computer use, telecommunications, and multimedia. Faculty were asked at this time to begin including technology activities within their course syllabi and to list the Heinich text as an optional text for students to purchase. In order to begin supporting faculty members in their endeavors, the technology committee proposed and received a small mini-grant to provide a series of full and half day workshops for full time and adjunct faculty with a focus on training in areas of technology and steps for integrating that technology into their courses.

Implementation of the program for all students in the Department of Education was scheduled for Fall, 1996. Plans for the fall included continued workshops supporting those students entering their professional student teaching semester and expected to complete a portfolio. A series of mini-courses was developed and offered to both student teachers and all other students. Education faculty were required to include the Teacher Technology Portfolio in their syllabus with opportunities for students to build competencies, to develop and field test activities with technology integration, and to reflect upon their experiences.

Evaluation, Revision, and Future Plans

During the pilot test of the program in the Spring of 1996, the student teachers were asked to complete seminar/workshop evaluations and a survey at the end of the semester about the portfolio process. Completed portfolios were assessed for number of competencies attained, number of lessons utilizing technology with artifacts, and the completion of a reflective statement on technology and education. Overall, the student teachers indicated a sense of the importance of learning to use and apply technology in the classroom. Although a variety of workshops at beginning and advanced levels were offered during student teaching seminars, many of the student teachers felt a lack of preparation to complete the portfolio satisfactorily. As well, a number of the students commented on the lack of technology in their field placements and therefore, the inability to implement the required lesson or unit plans.

Also during the spring, steps for preparing faculty to begin integrating technology into course work and supporting documentation of the student portfolios were begun. Results from a needs assessment, attitude survey, and the all-day workshop evaluation were compiled and indicated the same sense as the students regarding the importance of using technology as well as an equal need by the faculty for more adequate training on a variety of issues in order to be better prepared to infuse technology into their courses.

Based on the results from the pilot test and faculty evaluations, several revisions were made in preparation for the implementation of the program with all students in the fall, 1996. The portfolio guidelines were the first to be revised. Despite the fact that the student teachers were submitting technology portfolios, many completed portfolios were handwritten or typewritten. Specific instructions (with the requirement that all items must be completed on a word processor) and sample elements were developed. A bibliography of available library resources, procedures for documenting competencies from previous clinical or work experiences, and an evaluation checklist for the students to compete prior to final submission were also developed and included. Next, the supporting workshops for student teachers were revised to include a more specific focus on integrating technology into the curriculum, more hands-on, and some sessions for those students who were still fearful of technology. Additional stand alone mini-courses were developed and offered on basic instructional technology and using ClarisWorks for teacher productivity. Finally, plans were made for follow-up training for the faculty at the end of the semester and in the spring, 1997; improving the system for access and use of existing instructional software; and the printing of the portfolio guidelines and placement of them in the campus bookstore for purchase by the students.

Despite the fact that the faculty in the department have indicated the importance of and supported the need for this initiative, many still feel lacking in their preparation to actually implement technology in their courses. Others have expressed the desire to have the program more focused with clearer direction on what competencies and activities are expected in what courses. Stepping back and evaluating what has been completed so far, the realization that perhaps

the program has attempted too much too soon seems clear. A long range plan with phases of implementation has been developed with start up in the fall, 1997. The phases of implementation in the plan build upon a growing level of expertise in varying areas of technology by the faculty (and subsequently the students) with opportunities for training and the acquisition of necessary resources, materials and hardware to support the phase. Each phase focuses on a specific area of technology, such as productivity software, telecommunications, or presentation software, and includes objectives and competencies synthesized from several sources (ISTE, 1996; Northrup & Little, 1996; Todd, 1993).

Conclusion

The Teacher Technology Portfolio program represents a major initiative with the Department of Education at Elmhurst College to infuse technology throughout the course work of the preservice teacher and to provide an opportunity for continued reflection about the integration and application of technology into the curriculum. The program is designed to produce teachers who can use the technology available in the schools and effectively integrate that technology into their units, lessons, and activities. The program is attempting to achieve the goal of preparing new teachers to effectively use technology. "Technology is the catalyst, but the chemical starters for such fundamental changes are teachers highly skilled in technology, with a deep understanding of curriculum and a knowledge of how children learn" (Lee, 1996, p.12).

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Developing Student Generated Computer Portfolios

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At St. Mary's University of Minnesota, preservice teachers upon leaving the teacher education program are developing their own menu driven computer portfolios. Included in these computer portfolios are such items as text casts of philosophical beliefs, voice casts of effective teaching strategies, and digitized videos of actual teaching performance. This capstone project allowed preservice teachers an opportunity to both self reflect and assess their recent student teaching experiences.This computer portfolio project utilized Macromedia Director as an education software tool in the development of the preservice teacher's own portfolio. The use of this powerful software development program was viewed both by instructors and preservice teachers as a very valuable learning tool in preparation for teaching with technology. By having preservice teachers authoring their own electronic portfolios, it provided them with a greater understanding of how technology can be implemented into their future classrooms.

This project was not without some challenges. Some of the most problematic technical issues that students had to overcomes were; dealing with limited disk storage capacity, finding a balance between quality of video output and file size constraints, producing a usable end product for a job search, and creating CD-ROM versions of portfolios.

The process of preservice teachers developing their own computer portfolio however had many positive outcomes. First, these preservice teachers benefited by reflecting upon their student teaching experience as they compiled their own effective teaching characteristics. Second, the end product became a very valuable instrument in the student's job search. Third, the opportunity to author their own computer portfolio provided students with an increase capacity to infuse technology later in their classrooms.

The development of a computer portfolios through the use of Macromedia Director was an extremely valuable learning opportunity for our preservice teachers. Many of the preservice teachers spoke of their intent to take their new found knowledge of technology and apply it directly to their classrooms. In the end, both future teachers and their students will benefit directly from this process.

Value of Portfolios

My observations of students striving to put in place their most exemplar pieces of work along with writing and rewriting their most current philosophical foundations revealed a sense of value portfolios have upon my student teachers as they prepare to enter the profession. Their portfolio in the end represented, in essence, a capstone to their preservice teacher education. The pride of their accomplishments are now exhibited through their portfolio.

Furthermore, the reflection needed to successfully complete their portfolios provides a springboard to future development. They came away from this experience knowing that while they have made great strides in becoming solid young teachers, they still have much to experience and work towards in becoming outstanding teachers.

The value of creating a portfolio that will be shared with others makes the nature of this ortfolio not only an individual possession but also a public document. This development of a publicly shared portfolio requires people to be active, socially responsive, and willing to transform his or her teaching from a private to a public experience (Schram, Mills, and Leach,1995, p.71). By having students preparing a portfolio with one of the intended outcomes being its use in their job search, the portfolio becomes extremely public with regards to the quality of their personal teaching experiences.

The value of having students develop a portfolio for use in a job search makes this experience not only a exercise in reflective teaching, but also a very meaningful exercise tied to improving their opportunities for a job. This added component of producing a portfolio not only for their and our programs sake, but for others, resulted in preservice students placing even more emphasis upon the quality of their portfolios.

Determining the Portfolio's Content

There are undoubtedly a multitude of items that could be included in a preservice teacher's portfolio. Thomasena Adams (1995, p. 569) referred to the items that were to be collected to rest solely on the assessment information that is needed to respond to specific and general questions about

preservice teachers. In a somewhat similar way, I approached this question of what students needed to include in their portfolios by setting forth a set of standards that students should be able to demonstrate through evidence collected in their electronic portfolios. The major emphasis of our students' portfolios were to but forth their highest quality work which demonstrated the standards of knowledge, organization, and teacher effectiveness.

Because of constraints in data storage, students were restricted to selecting only the best pieces of evidence to be included in their electronic portfolios. They also were expected to maintain a more traditional portfolio which would contain additional evidence of meeting these standards of teacher effectiveness. Perhaps one of the most important factors I discovered in having students complete a computer generated portfolio was to allow them to determine how they were going to demonstrate their mastery of effective teaching. When preservice teachers are given the responsibility to demonstrate the standards based upon their analysis, synthesis, and evaluation of their evidence, it forces them to reflect upon the quality of teaching and learning taking place in their classroom.

Developing the Portfolios with Multimedia Director

The utilization of Multimedia Director as the software foundation for our students' portfolios was based upon the belief that it will better prepare our students to be more effective in infusing technology into their own classrooms. Perhaps one of the most beneficial uses of Multimedia Director is its value in producing a diverse set of multimedia applications for use in the classroom. Teachers who are well versed in Director can take advantage of this software with their students to teach them how to produce their own multimedia presentations.

The interactive capabilities of Multimedia Director script language allows for students to develop menu driven programs that are very user friendly. While this does require time for teaching students how to effective utilize the powerful tools Director has to offer, the benefits of this knowledge far exceeds the time requirement. With this project however, I choose to assist the students by providing them with a template which included the scripting needed to complete their portfolio projects. This was done to meet a time requirement that didn't allow for the necessary teaching of scripting versus time needed to develop their portfolios.

Students had access to a PowerMac lab (Mac 7500/100 with video input capabilities). To digitize their teaching videos, they utilized Apple Media Conferencing by recording into the self view window video clips from their teaching experiences. Since digitized video clips require large amounts of data storage, students who were planning on sending their electronic portfolios on 1.3MB disks with their resumes, choose to record their videos at one frame per second and set their sound preferences at a six to one compression. Videos were saved as quick time video files which were easily imported into a Director cast member for later use.

Students also scanned in images with the use of Photoshop. They then added any enhancements to those images and saved them as PICT files which Director utilizes. Students with images saved in a variety of other formats, utilized a graphics conversion program to place all images into PICT files before loading them into Director cast members.

Text cast members were either copied over to Director or composed right in the text cast page. Students were encouraged to compose utilizing a word processor before copying them over to Director because of the access to spell checkers in most word processing programs.

Positive Outcomes of the Project

I found three very distinct benefits from having students complete their computer generated portfolios. First, these preservice teachers benefited by reflecting upon their student teaching experience as they compiled their own effective teaching characteristics. Second, the end product became a very valuable instrument in the student's job search. Third, the opportunity to author their own computer portfolio provide students with an increased capacity to infuse technology later into their classrooms.

By engaging the students in developing their own portfolios, it required them to analyze what they had accomplished during their student teaching experience. They came away from this process with a clear understanding of how they were effective in the classroom and teaching areas they needed to refine in the years ahead. The work they did in developing their philosophy statements/beliefs further defined their understanding of what makes them effective in the classroom. Without spending considerable time reflecting upon these areas, the portfolio would have simply become a series of video clips and meaningless documents for others to view. The importance of communicating clear philosophical beliefs and following those beliefs up with documented evidence makes a truly significant difference in the quality of the portfolio.

I have little doubt that the technological expertise the students demonstrated with their computer generated portfolios had a very positive impact upon their securing job offers. While I did not conduct follow up interviews with school administrators who hired these students, several students returned from interviews with comments directly related to how impressed the interviewers were with their computer generated portfolios. In many ways, the use of computer generated portfolios sends a subtle, but powerful message that the educator who is applying for this job is computer literate. A knowledge base that many districts are seeking candidates with.

Included in this exercise were two teachers who had returned from their first year of teaching to complete the masters degree program. On several occasions, they made repeated comments about how they intended to incorporate Multimedia Director into their curriculum when they return to school. They were coming up with specific examples of how they could involve their students in a multimedia project and their beliefs that multimedia presentations are an important skill for students to master.

Traditional versus. Computer Generated Portfolios

Both types of portfolios have benefits and drawbacks. The strength of the traditional portfolio is that one is often looking at original documentation with an unlimited supply of materials. While the materials may be cumbersome to page through, and at times locate, access is generally available.

With a computer generated portfolio, the ease at accessing video clips with a click of the button is truly user friendly. Making duplicates of the portfolio is very easy and can be done at a minimal cost. However, it does require that the user has access to compatible equipment. The other drawback is the data storage limitation that a computer generated portfolio presents. Students wishing to utilize a 1.3 MB disk will only be able to record approximately one minute of video at one frame per minute to be include in their portfolio, those utilizing a CD-ROM disk will be able to record over 600 MB onto their disk. While the CD appears to be the answer to the storage demands of digitized videos and images, producing one for every application is both expense and time consuming.

One case study dealing with evaluating electronic portfolios found it to be clearly superior to paper portfolios because the ease of accessing the information (Bushweller, 1995, p. 19). The majority of computer generated portfolios developed by our students took between five and ten minutes to review. A time frame that should work well for school administrators reviewing teacher applications. These computer generated portfolios were produced for either Apple or PC's and required no special software for most computers before running.

Summary

Our students experience with building computer generated portfolios resulted in a very meaningful end product which allowed self reflection, a very user friendly product, and improved knowledge base in technology. As technology becomes more prevalent in our classrooms, the need to take advantage of utilizing computers for portfolio development is even more valuable. The limitations of data storage capacities faced by students today is quickly diminishing as access to larger storage devices become more available. In the future, the questions educators will be asking themselves isn't if they should utilize electronic portfolios, but how they should utilize them.

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READING AND LANGUAGE ARTS

Section Editors:
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Being a college professor in the waning years of the twentieth century is indeed exciting. We are challenged to incorporate technology, to increase the literacy skills of our youth, and to prepare literacy teachers for the next millennium. The eleven articles in this section highlight the increasing importance of weaving technology into our curriculum as we prepare tomorrow's literacy teachers. The authors have examined the use of technology in their own college classrooms, their own certification programs, and novel ways of using the newest literacy tools to enhance the reading, writing, listening, speaking, viewing, and presenting skills of elementary, middle, and high school students.

Most educators are enamored with the idea of technology, recognizing that it is an integral part of our culture, and have incorporated it within their daily teaching lives. The first paper in this section investigated the attitudes of college professors about the use of technology. Neilsen and Kiley present their findings on attitudes toward computer use in college settings. Given the positive outcomes, they discuss the importance of not only providing college professors and students with technology, but also with the technical support, including faculty workshops.

Inservice teachers seeking Masters' degrees will find innovative programs at several colleges and universities. Kahn's article provides a look at an exciting new Master's degree program that combines a Master's in applied technology with coursework for reading certification. Realizing the potential impact of technology on reading, Chestnut Hill College set our to create a degree program that prepares teachers to utilize technology to teach reading and to assume technology leadership roles in their schools. Enns and Auten describe the changes that were made in graduate education at the University of St. Thomas (St. Paul, MN). This new Masters' degree, based on standards established by the International Society for Technology in Education, prepares teachers to be creative, responsible, and to construct new ways of thinking.

While the foundations of new programs are pivotal, how we include these innovations within our graduate and undergraduate programs are also important. We know from experience and from research (most of it reported at this conference!) that it is essential to incorporate technology within our methods classes. Several papers in this section describe exciting and authentic classroom contexts for teaching literacy theories and research through technology. Peel and Ledford use children's literature with preservice teachers to make connections to geography and to the Internet. Focusing on Native American culture, they demonstrate how a children's book can teach history, values, and culture through the framework of the five themes of geography. They also provide the reader with several websites as resources that will add a technological dimension. Using quality children's literature is also the focus of the first of two articles written by Rader. She reports on the successes she has had at the University of Mississippi. Preservice and inservice teachers learned about using children's literature, the writing process, and various software programs to enhance literacy skills. She discusses the importance of determining story patterns and text structure as a foundation for developing individual stories, complete with graphics and computer enhanced illustrations. In the second article, she reminds us of the motivating nature of Language Experience Stories, updated for the new millennium via the use of technology.

Self-reflection is an important concept in the professional growth of teachers. If this process is ignored, we are no longer able to improve, and consequently become ineffective in our teaching. Given the rapid advances of technology, it is critical that we examine the technological elements in our college classrooms. Long and Reehm offer specific examples of readily available software to enhance reading and writing instruction in the language arts classroom. Their paper is based on experiences gained while teaching a summer reading/writing program for Reading Specialists. They stress the importance of teacher monitoring and using the appropriate software that will enable each reader to succeed. Hence, a variety of software is made available to their students to help them determine which

application will best suit the needs of children as they become competent, fluent readers and writers. Williams reflected on her own teaching practices as she examined assignments and class activities in her language arts class over a three-year period. Concluding that the use of technology evolved due to the changing needs of preservice teachers, she advocates the need for reflexive examination of teaching practices. This reflexive evolution requires continued dialogue between students, professors, and school personnel.

As we prepare teachers to work with children, we become aware of the difficulties that face today's classroom teachers. The wide range in cognitive and behavioral abilities, coupled with the complexities of economic and cultural diversities can be frustrating to some. Two authors in this section weave the concept of cooperative learning with technology to better meet the needs of elementary school children. Zhang examines the integration of technology as a means of meeting the needs of mainstreamed learning disabled students into a fifth grade classroom. Through this collaborative experience, preservice teachers are also provided with an authentic classroom experience. Silvia, Antonella, Luisa, and Mario's study examines students working in cooperative groups to explore their environment and to share the information they discover with students in Italy using an interactive software application, Our World. The final article in this section offers us suggestions to use with all learners. Taylor discusses some of the technology innovations available to reading teachers as they work with students in their classrooms. Multimedia, reading environments provide electronic supports for children as they develop reading competencies. These electronic advancements are seen as supplements to the printed texts in the classroom. With teacher support and guidance these electronic texts can facilitate children in the process of becoming independent, life-long readers.

The articles in this section provide a kaleidoscope of uses for technology and motivate us to reflect upon how we use technology in our very own teaching lives. We believe that using technology within authentic contexts better prepares our students to teach tomorrow's children.

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College Faculty Classroom Computer Use: Implications for Student Achievement

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As the new millennium approaches, nations are recognizing the necessity to harness technology efficiently. The need for a well-prepared work force demands that teachers and their students are technologically literate. Regretfully, funds have not been readily available for the purchase, and installation of computers, or for appropriate staffing and maintenance. Additionally, some college professors, despite expertise within specific academic areas, may lack specific skills when using technology. This paper focuses on one college's efforts to provide adequate computer resources and technical assistance to their faculty during the spring of 1997.

Larsen (1983) reported that only 25 percent of 200 college chemistry faculty nationwide used computer-based instruction in their classes even though 68 percent were familiar with computer-based education. Lillard's (1985) study of 200 K-12 Pennsylvania teachers indicated that attitudes towards computer use could be predicted both from the respondent's level of knowledge of computers, and willingness to use computers. Of the 144 University of Illinois faculty surveyed by Jacobson and Weller (1986), those over 40 years of age used computers more skillfully and more often than colleagues in their 30's. However, five years later, Harold's (1992) study of 171 professors of adult education across the nation found a significant negative relationship between age and computer use (older faculty used the computer less and experienced greater computer anxiety e. Hawes (1992) study of 96 faculty of a New Hampshire college found significant differences between r computer anxiety). Terry and Geske's (1990) study of a 21 member faculty teaching journalism and mass communication found that the level of use was affected by how the participants obtained assistance for computer problems. The reason most cited for lack of computer usage was the respondent's lack of information. Conroy (1991) reported significant differences between Maryland secondary teachers of required and elective courses; those who taught the electives used their computers more often. The study of Ohio universities by Faseytian and Hirschbuhl (1991) found highly significant differences in computer usage between those who required student use of computers in their course work and those faculty who did not require student computer use. The technological orientation of the faculty's discipline was a significant predictor of computer usage stages of concern and levels of computer experience, and interest in learning new software and discipline groups. Shifflett, Richardson, Ghiasavand, Plecque, Verduzco, and Thomas (1993) examined the faculty of the California State University system and found that so few faculty members used computers to communicate with each other or to access information services, that the integration of computers into the classroom would take a considerable amount of time. When Broom (1994) investigated the faculty in the University of Georgia system, the significant factors for predicting instructional use of computers were use of e-mail, and the faculty member having been employed in private industry.

Procedure

The participants for this study included 120 faculty members at a private liberal arts college in York, Pennsylvania. The college enrollment is approximately 3.400 from Pennsylvania, New York, and Maryland. Almost 75 percent of the faculty have doctoral degrees. Since 1995, a local electronics communications network was created for faculty use of e-mail, voice-mail, and access to the Internet. Classrooms and laboratories were also equipped with LAN drops. Faculty have been provided with computer workshops since 1996.

The participants were invited to complete a 41- item questionnaire modified from Lillard's (1985) study. Questions were developed to determine if attitudes towards computers were affected by knowledge about computers, gender, number of years teaching, or by subject matter. Fifty-five usable surveys were returned by 22 female and 33 male respondents. Twenty-six taught technical course (Biology, Physical Science, Computer Science, and Nursing) and 29 taught non-technical courses (Behavioral Science, Business Administration, Education, English & Humanities, History & Political Science, Music, Art, Speech, and Communication). Six of the respondents taught at the college level for 1-5 years, seven taught at the college

level for 6-10 years, 21 taught 11-20 years and 21 had more than 21 years of college teaching.

Data analysis and findings

The questionnaires were collected and analyzed by a series of analyses of variance (ANOVA) using SPSS 4.1 (Statistical Package for Social Sciences) to determine statistical significance at the .05 level. No significant differences resulted between attitudes toward computers as instructional tools and knowledge of computers. However, the value was very close to significance. Almost 90 percent of the respondents owned computers; nearly 93 percent had attended seminars and workshops; and 76 percent supported the college's efforts toward greater computer access and technical assistance to faculty. No significant differences resulted between attitudes toward computers as instructional tool and gender, number of years of college teaching experience, and subject matter taught (technical or non-technical). These respondents' perceptions of computers as instructional tools were very positive. Almost 90 percent did not feel that computers were cost prohibitive; and almost 93 percent felt that computers were useful as instructional tools.

Attitudes toward how computers will affect teaching were also positive. Almost 96 percent felt that colleges should use computers in their instructional programs; 85 percent felt that computers can improve the quality of education for the students; 95 percent said that the colleges should purchase computers for instructional use; 91 percent agreed that implementation of computers for instruction should be encouraged; and 100 percent felt that students should have access to computers in colleges. How computers in the classroom affected students brought about more positive attitudes. Sixty-seven percent did not feel that computers caused students to be isolated for each other; another 86 percent thought that computers help students learn; and almost 78 percent did not feel that computers dehumanize colleges. Personal perceptions dealing with computers in general were also very positive. Seventy-eight percent enjoyed working with computers; almost 74 percent did not feel apprehensive about learning how to use computers; and 91 percent did not feel that using computers required a strong background in mathematics.

Implications

The very positive attitudes of this faculty toward computer use in their classrooms provide evidence that, given the equipment, training, and technical support, faculty welcome assistance to master this vital learning tool. Continued research is justified to ascertain whether those positive attitudes continue; whether faculty computer use will be limited to word-processing or will develop into more sophisticated applications. Ascertaining ilevels of anxietyî as faculty attempt more difficult tasks and levels of teacher-student collaboration via computer might well be examined. Additionally, faculty may be surveyed regarding their present and future use of this valuable educational tool. Failure of the faculty-at any level- to maintain competence and to continue to develop computer expertise will be detrimental to American education.

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Preparing a New Professional: Applied Technology and Reading Certification

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The Education and Applied Technology Departments of Chestnut Hill College have collaborated to create a new strand in the Master's in Applied Technology degree program. This strand combines the coursework for the Master's in Applied Technology degree with coursework in Reading Certification. This degree program builds on the demonstrated strengths of our two departments and acknowledges the value of technology in the reading/writing/language arts curriculum. Graduates of the program should be highly sought after by schools and school districts seeking to infuse technology and literacy throughout the curriculum. This program is the only one of its kind in the state of Pennsylvania, and response to as been enthusiastic.

Currently the Education department at Chestnut Hill College offers Master's programs in Early Childhood Education, and Elementary Education, as well as early childhood, elementary and secondary certification. Our Applied Technology Master's program offers a strand designed for educators, as well as strands in leadership and in instructional design. Each of these programs attracts well-qualified students and prepares them, according to the mission of the College, to be leaders in their fields.

This program was created because we are aware of the powerful synergy created by the informed incorporation of technology and software into educational practice. Students in the Education department at Chestnut Hill are encouraged to take courses in Applied Technology, and a significant number of Master's candidates in Applied Technology have simultaneously become certified through the Education Department. Our two departments share a constructivist philosophy of education, in which whole language strategies and integrated learning are stressed. In all our programs students are encouraged to design and evaluate practice in terms of sound pedagogical theory. As students cross-register, their appreciation of the relationships among curriculum design, educational practice and technology widens and deepens.

Our own pedagogical judgments suggested that the creation of a Master's degree in Applied Technology with state certification in Reading would acknowledge and finalize the relationship between powerful technologies and sound literacy theory. Believing that literacy is a multifaceted, complex process, we have designed a program, based on a working relationship between our two departments, to prepare school leaders for the future. We began accepting candidates for this combined program in the 1996-97 academic year. We continue to accept new candidates and to design new courses, in which literacy development and technology use are reconceptualized.

This program targets certified teachers who seek to further enhance their performance in the classroom, and/or as leaders within their schools or districts. Teachers who already have Master's degrees in education will find an opportunity to refine competencies, increase income, and explore new professional challenges. The program has been designed specifically to provide expertise and state certification in reading, in conjunction with competence in the uses of all forms of technology, especially in the language arts curriculum.

Program Rationale

The link between the reading/writing curriculum and technology can be powerful. For developing readers and writers, technology can scaffold and support emerging literacy, through the use of multisensory approaches and timely feedback. Research has demonstrated the ways children's perceptions of the writing task change when the tool is changed from pencil-and-paper to word processing, "writing in light" (Kahn, 1988; Cochran-Smith, Paris & Kahn, 1991). New reading software, including CD-ROM storybooks and game formats about literature, changes the ways children experience books and reading. Instrumental reading in text-based computer games invites children to read for authentic purposes. Computer conversations via email involve children in timely reading and writing activities with peers and mentors (Jody & Saccardi, 1996). Moreover, teachers become aware of the wide spectrum of literacies their students possess and of the necessity to assist students to refine those literacies.

This degree program combines technology with the best reading/writing techniques. Currently the move in schools is away from self-contained labs and towards the presence of technology in every classroom. This degree program will graduate a new kind of reading specialist, who understands the contributions of technology to the reading/writing curriculum. Children with reading and writing difficulties will be better served by this new professional. Children can learn to read using CD-ROM storybooks and learn to write using word processing rather than pencil and paper. New research suggests that reading difficulties can be minimized or eliminated through judicious use of software, and numerous studies document that students write more and write better using technology (see Cochran-Smith, 1991 for an extensive review of these studies).

Goals of the program

In our proposal to the state of Pennsylvania, we identified the following goals of the program:

1) To prepare teachers to serve as technology experts in their schools;
2) To prepare teachers to serve as reading specialists in their schools;
3) To prepare teachers to work with classroom teachers, facilitating the integration of technology across the curriculum, especially in reading and writing;
4) To prepare teachers to identify the research and pedagogical issues involved in the use of technology in the English language arts.
5) To prepare teachers to use technology in reading and writing to assess and evaluate the progress of all students, including those "at risk."

We designed this program, therefore, for certified teachers who bring to their coursework strong foundations in teaching and a wide range of classroom experiences to share with their colleagues in the program. We seek those candidates who wish to assume broader leadership roles in their schools, and help them develop the expertise in technology and reading to enable them to do so.

Designing the program

In creating this master's level program, we had to deal with issues concerning the integrity of the degree. The existing Master's program in Applied Technology was a 12 course, 36 credit program - how then to add the necessary courses for Reading Certification without making the program too ambitious to be attractive? Let me walk you through our reasoning and show you how we have conceived this program.

Currently, students in the Education strand of the Master's program in Applied Technology take the following courses:

Technology core

- Video Communications
- Online Communications
- Modes of Thinking
- Seminar

Education core

- Learning Theories
- Technology in a content area (language arts, social studies, math, science or the arts) Professional Issues and Curriculum Development
- Technology in the Curriculum

Research core

- Statistics
- Research Methods

Electives

- Choose two from the following courses: networking, presentations, authoring languages 1 & 2, advanced video, multimedia presentations

Our rationale for the original degree program in applied technology is to prepare classroom teachers to be leaders in their profession, using technology to enrich and enhance the curriculum. It is our contention that critical pedagogy extends to and applies to the use of technology in schools. We are committed to maintaining the integrity of the degree, insisting that all of our graduates be able to think about curriculum; analyze other people's research; design and conduct their own research; and develop ways to integrate technology into the curriculum. We could not award the degree without having all our students demonstrate the same competencies.

So, how could we develop a program that added reading certification without creating an unwieldy, overburdened list of courses? We spent a semester talking about the professional we hoped to educate, and the likely candidates for this degree. Those discussions were helpful in defining our population and tailoring the program to their educational histories.

In order to be a reading specialist in Pennsylvania, one must possess Instructional I permanent certification, which is awarded after 3 years of satisfactory teaching, and completion of 24 semester hours of post-baccalaureate study. As an aside, most teachers opt to complete a 36 credit Master's in Education, since there is a significant difference in pay at the Master's level. Therefore, we reasoned, anyone who would enter our program would have accomplished this already, since they could not be certified without Instructional I permanent certification. That caused us to look at our courses and decide which of the Applied Technology courses might be duplicated somewhere in the 24 semester hours required for Certification.

We identified three courses that would probably be included in any master's program in Education: Statistics, Research Methods, and Learning Theories. In addition, we eliminated the technology in the curriculum seminar, since those issues would be covered in other courses (we had a

precedent for this in the Leadership strand of the Master's in Applied Technology, which only had one semester of seminar). So the technology core is kept intact, the education core is focused in the English language arts, and we assume that the candidate has already taken learning theories and the research core in their previous master's degree coursework. This enabled us to add four courses in reading, to meet Pennsylvania competency requirements and two electives.

Our program is, then, structured in this way:

Technology core

- Video Communications
- Online Communications
- Modes of Thinking
- Seminar

Education Core

- Technology in the English language arts
- Professional Issues and Curriculum Development

Reading Core

- Reading and Writing in the Elementary School
- Reading and Writing in the Secondary School
- Building Literacy Competencies
- Evaluation and Assessment

Electives

- One from the technology core:
- Advanced video, Presentations, Networking, or Authoring languages One from the education core:
- Problems of Development or Inclusion

The program begins with Technology in the English language arts, a course that has been an offering of the Master's program in applied technology since 199 1. The course begins by examining the NCTE/IRA standards for the English language arts. Students read Frank Smith's (1 997) Reading without Nonsense as well as Learning to Write Differently: Teachers and Children Using Word Processing (Cochran-Smith, Paris & Kahn, 199 1). These two books give a perspective on whole language values and practices, a perspective that is continued throughout the course. Other texts include Technology, Reading, and Language Arts (Willis, Stephens, Matthew, 1996), Spelling in Use (Laminack & Wood, 1996) and Computer Conversations (Jody & Saccardi, 1996). Each was chosen because of its explicit articulation of the connections between language learning theory and methodology.

The second level of this course is entitled Professional issues and Curriculum Development. It is a requirement of every graduate student in the education strand of the Master's in Applied Technology, taken after a discipline-specific course such as Technology in the English language arts or Technology in the Math (Science, Social Studies) Classroom. This course prepares graduate students to become resource persons in their schools, with expertise about the research literature, mastery of observation and evaluation techniques, and the ability to plan and conduct workshops for their colleagues. The assignments are identical for students in each discipline: an annotated bibliography; an observation of students using technology; and the planning and conduct of a workshop for adults. In this way, we afford scaffolded experiences for our students and help them to develop knowledgeable perspectives concerning roles of technology in the English language arts.

The program's new courses in reading are designed and taught by a member of the education faculty who is a reading specialist and adjunct faculty members who will take responsibility for regularly teaching one particular course in their areas of expertise. We see our program offerings as unique in the state, not only meeting the requirements for state certification, but also conceptualizing a specialist who understands the various forms of literacy our students must possess, has expertise in the design and evaluation of research about reading and writing, and understands alternative forms of assessment (portfolios, holistic scoring, etc.) well enough to teach it to classroom teachers.

We assume that our students have taken a course in children's literature and if they have not, we strongly urge that they do. In addition we require a new course entitled Building Literacy Competencies in which our graduate students examine multiple symbol systems, multiple intelligences, and assemble materials (both print and non-print texts) to help children learn to read. What can we learn from fiction? from textbooks? How do we learn it? What do movies teach us? What information can be gleaned from maps and charts, signs and logos? We argue that there are many ways to know the world and that students need to develop expertise in each of those ways. While the reading list for this course is under development, it will certainly include Mind in Society (Vygotsky, 1978) and selections on the nature of literacy.

We offer two courses in methodology: Reading and Writing in the Elementary School and Reading and Writing in the Secondary School, since reading specialist certification covers grades kindergarten to twelve. Each of these introduces a wide variety of strategies for helping children become literate, and provides the graduate student with tools to use in the practicum. We expect that many of our graduate students will do their practicum assignments within their own schools, under the supervision of their building reading specialists, but some of our students may prefer to work in a reading clinic during the summer, either at our campus or on a neighboring college campus.

The fourth reading course addresses the issues of diagnosis, evaluation and assessment. During this course, our prospective reading specialists will be assigned children whose assessment and programs they will design and administer. Throughout the program the focus will be on discovering children's strengths, rather than documenting

their weaknesses. Our intent is to help children use their learning styles and their strengths to develop proficiency in the use of symbol systems.

The final seminar will be formatted in an unusual way. The goal of the seminar is to prepare a reading specialist to evaluate a reading program, both qualitatively and quantitatively. This created a scheduling problem for us, since we are committed to research extended over time. Our solution was to stretch the seminar over two semesters, to provide that extended time for research. The seminar will meet in September and early October to help graduate students formulate their research questions, review the appropriate literature and design their projects. Then, from mid-October to late February, our graduate students will conduct their projects, collect and begin to analyze data, and fine-tune their proposals, while in contact with the professor. The class will meet again in March and April to provide support as students interpret and organize their findings for publication. The course is a three-credit course, spread over two semesters, a format that enables us to do meaningful research in real world settings.

Summary

This program has been designed to combine coherent theories of literacy acquisition and development with the judicious use of various technologies and media. Our goal is to prepare a professional with expertise in several areas: in dealing with individual children; in creating and implementing curricula; in working effectively with classroom teachers; and in designing and critiquing research. Towards these ends we have created assignments and readings that enable our graduate students to move into positions where they can help classroom teachers reconceptualize literacy and literacy instruction.

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Reflective Active Participation in Graduate Education

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The University of St. Thomas (UST) recognized the need to include technology in degree programs in the late 1970's just as the first Tandy and Apple IIe computers found their way into classrooms. By 1981, UST offered students a Learning Technology Master's Degree program, a professional growth degree with emphasis on models of learning; instructional design and evaluation; and technology's role in design, delivery, monitoring and evaluation of educational programs. From the mid-1980s to 1995, over 500 teachers throughout the state of Minnesota participated in this degree program. After an intensive review process, the Organizational Learning & Development Program of the University of St. Thomas recommended that in order to maintain a timely, state-of-the-art program, it was necessary to redesign the degree structure and curriculum offerings of the MA in Learning Technology. The task was accomplished in early 1997. A new cohort of eighteen students began their studies in Learning Technology in the summer of 1997.

Master Of Arts Degree in Learning Technology

The Master of Arts Degree in Learning Technology is designed for professionals who provide leadership in educational applications of technologies. The program focuses on the integration of information technology, models of learning and instruction systems design, and preparation that lead to proposed certification or licensure in information technology in Minnesota.

Reflective Active Participation

The program is a cohort model that asks the participant for an active engagement in the learning process leading to the presentation of a professional portfolio and an internship project. The program model provides a cadre of support for each cohort including an advisor for course participants, a mentor for course instructors, and a design team to ensure the alignment of current research, course instruction, and participant reflective response. The program recognizes adult learners as reflective professionals in search of meaning as they experience the ever-changing technological applications for teaching and learning. Adult learners who are seeking professional growth in their teaching and administrative positions need to understand and demonstrate the essential skills of technology as well as communicate, plan, design and implement innovative changes in classroom, school and community settings. As adult learners respond to course requirements and reflect on meaning-making moments, they will realize a transforming process that will lead to the construction of innovative professional thought and practice.

Assessment and Professional Development Planning

This course is offered throughout the degree program in three one-credit increments at the beginning, middle and end of the course of study. It focuses on the organization of a digitized portfolio that includes a professional assessment of technology skills based on standards established by ISTE. The course presents a dialogue on the process of assessment leading to the mastery of technology skills needed for professionals who provide leadership in educational applications of technology. This dialogue is embedded in actual problem-solving activities that can only be resolved by active engagement with technology. Through collaborative learning process participants form their own assessment format and design a strategic plan to accomplish their goals.

Synchronous and Asynchronous Reflection

Throughout all course work, participants will recognize the integration of technology infused in instruction, presentation and assessment. Instructors and participants must engage in discussions that include opportunities for e-mail interactions, web site discussions and video conferencing. All course work must demonstrate synchronisity through integration and interactivity, but also asynchronisity that encourages participants to diverge and engage in dialogic conversation through innovative technological advancements. Note in the sample excerpt of the ISTE standards how participants engage in this reflection.

Weaving Literature and Geography Through Internet Connections

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Effective methods courses assist pre-service teachers in developing strategies for instruction and in understanding the value of subject integration in facilitating their students' development of concepts. When teaching pre-service teachers, including an example to illustrate concepts such as integration provides a concrete application to connect theory to practice, as well as ideas for lessons to be taught in elementary classrooms. Since reading is a major focus in all elementary classrooms, pre-service teachers can certainly relate to examples which use literature to integrate a variety of subject areas. By providing an illustration for class discussion which incorporates Internet resources, teacher educators are modeling technology integration as well. Teacher educators must model lessons which use technologyñInternet references for lesson preparation, student activities using Internet resources and databasesñif we expect beginning teachers to see technology as a viable tool in their classrooms. The following example provides a model for discussion in pre-service classes as well as a unit for instruction in elementary classrooms by integrating language arts and social studies through Internet connections.

The values of using multiethnic literature with elementary children are many. Lessons can address issues faced by minorities, similarities in human experience, artistic contributions in arts and humanities, respect for diverse value systems, geographic and historical facts, sociological change and social sensitivity. Studying a group of people by addressing these issues allows students to connect history and the present, and to consider events and situations from a viewpoint different from their own. McGowan, McGowan, and Lombard (1994) suggest that linking literature and social studies complements reform efforts in the social studies curriculum arena to encourage student engagement, subject matter integration, global awareness, social participation, and the formation/application of significant ideas.

Literature of Native American cultures provides an excellent vehicle for identifying and understanding tribal traditional values and beliefs and a source for integrating numerous content areas into lessons (McGowan & Guzzetti, 1991). Often, students acquire superficial views of Native Americans by being introduced to certain stereotypic components of their cultures. This can be avoided by studying the culture through literature such as folk tales, which provide students an opportunity to understand the central values of the culture and how these affect everyday lives (Franklin, Roach, & Snyder, 1993). A selection of literature which allows students to consider events from a different viewpoint, to reflect on the impact of a particular historical event, and to connect the past and present is Death of the Iron Horse (Goble, 1987). Goble's beautifully illustrated folk tales is based on a specific factual event involving a train derailment by the Cheyenne people and their attempt to protect their land. In the book, Goble uses words and pictures to illustrate the similarities as well as the unique qualities of the culture and creates images that denote the way of life, artifacts and symbols, and traditions. The story reflects the cultural values of living in harmony with nature and emphasizing group and extended family needs rather than individual needs. The story portrays differences in cultural values placed on material possessions and the limited impact of the Cheyenne people's heroic attempts to stop the changes brought by the invasion of their lands.

One strategy for using Death of the Iron Horse to teach history, values, and culture of a particular group of Native Americans is to focus on the five themes of geography: location, place, relationships within places, movement, regions/neighborhoods (Joint Committee on Geographic Education, 1984). These themes provide a framework for gathering information through a variety of sources, including the Internet, about the past and present. Suggestions for addressing the five themes of geography through this literary selection follow.

Connecting Literature and The Five Themes of Geography

1. **Location:** Position on the Earth's Surfaceñdescribes where specific points are located on the earth's surface and where certain points are in relation to others.
   - Use maps to locate the home of the Cheyenne nation discussed in the story.

- Plot the westward expansion of the railroad.

2. **Place:** Physical and Human Characteristicsñidentifies the distinctive characteristics of areas (physical or human) that distinguish them from other places.
   - Collect information about the climate of the Great Plains.
   - Discuss implications for the natives who lived thereñhousing, clothing, agriculture.
3. **Relationships within Places:** Human-Environmental Interactionñcharacterizes the ways people react to and sometimes change their environment.
   - Compare and contrast the viewpoints of the tribespeople and the white men concerning the advantages and disadvantages of the railroads expanding westward.
   - Find passages from the book which illustrate the tribespeople's respect and concern for the environment.
4. **Movement:** Humans Interacting on the Earthñcharacterizes how people travel from one place to another, communicate with each other, or rely on products, information, or ideas from other places.
   - Compare and contrast how Native Americans and White Men communicated and traveled.
   - Discuss differences in values placed on products/material possessions.
5. **Regions/Neighborhoods:** How They Form and Changeñclassifies areas that display similarities of selected features (landform, climate, natural vegetation, religions, land use, culture)
   - Identify changes in the region that occurred following the coming of the railroad.
   - Examine how the Plains Indians live today; investigate occupations, government structure, schools, family or national traditions.

Internet Resources

The Internet can be used as a valuable resource for teachers and students engaged in these activities focusing on the five themes of geography. Native American and environmental websites provide resources for gathering factual information about regions and people. The following websites are useful resources to further expand children's perspectives of history, culture, values, and traditions.

Multicultural Bibliography
http://falcon.jmu.edu/~ramseyil/mulnativ.htm
Includes links to bibliographies of Native American literature by genres and regions of North America; provides teacher resources and reference materials.

Index of Native American Resources on the Internet
http://hanksville.phast.umass.edu/misc/NAresources.html
Provides links to art, archaeology, music, and history of Native Americans; supplies a rating of each of the sites.

World Wide Web Links to Native Americans
http://www.charweb.org/neighbors/na/na-link.htm
Provides an index of resources on the Internet as well as the Bureau of Indian Affairs.

U.S. Environmental Protection Agency
http://www.epa.gov/regional/indexslt.htm
Provides links to state, local, and tribal environmental networks.

Envirofacts Warehouse
http://www.epa.gov/enviro/
Generates environmental databases and maps.

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Using Children's Literature to Integrate Reading, Writing, and Multimedia Technology

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Preservice and inservice teachers enrolled in elementary education classes at the University of Mississippi during the spring and fall semesters of 1997 learned first-hand how to use children's literature to integrate reading, writing, and multimedia technology. Selected trade books and children's literature selections provided writing prompts for students' own stories that were composed and illustrated online, using word processing, paint, and presentation software applications.

Method

Students enrolled in EDRD 350 Computer Technology and Reading Instruction, EDRS 557 Computers in Education, and EDEC 553 Language Concepts and Literature in Early Childhood were instructed in technology, the writing process, and elements of story structure in children's literature. In an attempt to provide these preservice and inservice teachers with authentic opportunities to integrate children's literature and the writing process with technology, practical applications were established. Several stories, based upon students' understandings of story patterns and structures were selected as writing prompts. These included The Important Book (Brown, 1990), Together (Lyon, 1989), Brown Bear, Brown Bear, What Do You See? (Martin, 1996), Polar Bear, Polar Bear What Do You Hear? (Martin, 1997), If You Give a Mouse a Cookie (Numeroff, 1985), and If You Give a Moose a Muffin (Numeroff, 1991). Some of these books provided opportunities for students to create online stories, while others were more suited for paired writings, illustrations, or for whole class composition.

Writing and illustrating as individuals, as partners, and as groups

Although The Important Book was written by Margaret Wise Brown in the late 1940's, it has remained one of her most beloved children's classics. The author focused on what was important about several things that are familiar to most children, describing the attributes of a common item, always ending with the pattern "but the important thing about a ... is that it is..." This story pattern was quickly recognized by students. They were provided time to reflect on what was important to them and why. The next step of the writing process required computer time. They composed their text in Microsoft Works and illustrated them using Microsoft Paint. Both text and drawings were then copied and pasted onto pages or slides in Adobe Persuasion. The resulting product was the publication of the students' work— "Our Important Book" online.

The story pattern of Together (Lyon 1989) focuses on corporation and collaboration. After listening to, discussing, and experimenting with the language pattern and structure of the story, preservice and inservice teachers worked in pairs to compose original text and illustrations for their own online versions.

The two highly popular books by Bill Martin Jr. (Brown Bear, Brown Bear, What Do You See? and Polar Bear, Polar Bear, What Do You Hear?) also provide story patterns that allowed preservice teachers to follow a similar procedure for writing and illustrating stories online. Finally, two Books written by Laura Joffe Numeroff, If You Give a Mouse a Cookie and If You Give a Moose a Muffin, provide delightful stories with more complex patterns and structures.

Lessons Learned

Preservice and inservice teachers learned how to share quality children's literature with children, using it as a writing prompt to create stories that may be published online. They also discovered that this process approach to writing may be constructed for individuals, for pairs, or for small and large groups. Additionally, they learned valuable file management and transfer skills by working with multiple applications. Most important, however, they actually integrated reading, writing, and multimedia technology by using simple, fun children's stories.

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Preservice Teachers' Achievement and Attitudes in Creating Language Experience Stories

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Traditionally, language experience stories (LESs) have been used as a means of teaching children to read and write. "Young students typically dictate experiences to their teachers, who print them on paper, recording the students' exact words. These experience stories then become the basis for reading instruction (Rader, 1997, P. 797) Older students print or word process their stories, adding drawings, photographs, clip art, or other graphic images for illustrations. The resulting LE are not only meaningful but also highly motivating since they provide an opportunity for students to express themselves, writing about their personal lives and experiences to share with others.

The Language Experience Story Project

As part of their course requirements for EDRD 350 Computer Technology and Reading Instruction at the University of Mississippi, 97 preservice teachers were assigned LES projects. The participants ranged in age from 19-46 with an average age of 23 years. (See Table 1 for gender and ethnicity information.) Each preservice teacher was required to follow the writing process (prewriting, drafting, editing, revising, proofreading, and publishing) and desktop publish a LES, using photographic images for illustrations. Preservice teachers were required to produce their LESs in duplicate-one for themselves and one that would be placed in a software library housed at the college of education.

Table 1.
Participant Information

Gender and Ethnicity

	White	African American	Hispanic	Total
Females	84	07	01	92
Males	04	01	00	05
Total	88	08	01	97

Procedure

Preservice teachers were first introduced to the traditional language experience approach (LEA) used to promote the reading and writing skills of young children. Then, each section of the course created a group story entitled iOur Manual Alphabet Book.i Since there was a hearing impaired student enrolled in this class, preservice teachers were taught the manual alphabet and show how the LES process could be used to promote the acceptance and understanding of inclusive students.

Preservice teachers received several class periods of computer technology instruction that included formatting skills for their LES notebooks. These skills included how to create covers (portrait orientation) and spines (landscape orientation), modification of font faces, types, types and sizes, and the development of text boxes, borders, and graphics. In addition to the basic skills needed to successfully complete this assignment, students were also required to obtain and learn about e-mail accounts. This process allowed the students the opportunity to communicate with each other and the instructors.

At the end of the semester, the participants were asked to complete a 20-item questionnaire targeting their levels of comfort using the computer, technological skills, and knowledge of the writing process before and after the project. (See Figure 1 for questions.)

Language Experience Story Questionnaire

Directions: Now that you have completed your LES, please provide the following information and answer the following questions to the best of your ability.

1. Name
2. Age
3. Gender
4. Ethnicity
5. The title of your LES is...
6. Before you began your LES, what was your level of comfort using the computer? (Rate your comfort level on a scale from 0-10 with 0 indicating no comfort using the computer to 10 indicating complete comfort using the computer.

7. After you completed your LES, what was you level of comfort using the computer? (Rate your comfort level on a scale from 0-10 with 0 indicating no comfort using the computer to 10 indicating complete comfort using the computer.)
8. Before you began your LES, what was your level of computer technology skills? (Rate your computer technology skills on a scale from 0-10 with 0 indicating no computer technology skills to 10 indicating expert technology skills.)
9. After you completed your LES, what was your level of computer technology skills? (Rate your computer technology skills on a scale from 1-10 with a 0 indicating no computer technology skills to 10 indicating expert computer technology skills.)
10. Before you began your LES, what was your level of understanding the writing process in education? (Rate your understanding of the writing process in education on a scale from 0-10 with 0 indicating no understanding of the writing process in education to 10 indicating complete understanding of the writing process in education.
11. After you completed your LES, what was your level of understanding the writing process in education? (Rate your understanding of the writing process in education on a scale from 0-10 with 0 indicating no understanding of the writing process in education to 10 indicating complete understanding of the writing process in education.)
12. List as many of the computer technology skills that you have learned during this project. Use the back of this paper as necessary, Provide explanations as needed.
13. Please consider the costs of completing this project in time and money. First, how many hours did it take for you to complete this project? Secondly, how much money did I t cost?
14. Do you plan to share your LES with the students when you are in the schools?
15. What are some of the things that your LES teaches?
16. What grade level or range applies to your LES?
17. When you desktop published your LES, how much did you use the school of education computer lab, your own computer, or other computer facilities? (These figures should add up to 100%.)
18. Please write five sentences explaining your feelings about the LES project.
19. Have you shared your completed LES with others? If so, what were their reactions?
20. Do you plan to create other LESs with your future students?

Figure 2. The Language Experience Story Student Questionnaire.

Results

The questionnaires were collected and compared using paired samples t-test. Results indicated statistical significance for all three comparisons. Participants reported a mean level of comfort using the computer of 5.76 at the beginning of the class and 7.91 at the conclusion of the semester, with a mean difference score of 2.87. The paired samples t-test indicated that there was a statistically significant difference at the 0.01 level [t (96) = 11.98; p <0.00]. On the level of computer technology kills, participants reported a mean of 5.66 prior to the experience and 8.36 after completing the course, with a mean difference score of 2.61. The paired sample t-test indicated that there was a statistically significant difference at the 0.01 level [t (96) = 15.53; p< 0.00]. Finally, on the level of understanding the writing process in education, the participants reported that their mean levels of understanding were 5.04 prior to instruction, and 7.91 after, with a mean difference score of 2.87. The paired sample t-test indicated that there was a statistically significant difference between preservice teachers' understands at the 0 01 level [t (96) = 12.90; p< 0.00].

On the open-ended questions, the participants reported over 80 computer skills learned in the duration of the study. The top six are: how to work with text boxes and borders for photographs (74); how to change the page orientation and create a notebook spine (40); how to work with fonts, including resizing (36); how to insert graphics and clip art (35); how to create a cover page (18), and how to insert page numbers (15). Participants reported that it took from 4-96 hours (average of 16.5 hours) and cost $10.00-120.00 (average $34,00) to complete the LESs. It should be noted that several preservice teachers chose to purchase special paper, software applications, and hardware components in order to complete their projects. Overall, (89.69%) the participants reported that they would definitely share the LESs with future students, with the remaining preservice teachers indicating that would most likely share the project.

The topics of the LESs included animals or pets (34), specific literacy (22) or mathematical (14) skills, cooperation (14), and love of friends (9) and family (9). The targeted grade level ranged from preschool to middle school with the majority of preservice teachers writing stories for kindergartners, first and second graders. The projects were developed using the computers in the college of education computer lab (78%), on personal computers (18%), or on other computers (4%).

Each preservice teacher wrote five sentences responding to the project. These comments were analyzed and classified as either all positive (5 positive sentences); mostly positive (3-4 positive sentences), mostly negative (3-4 negative sentences), all negative (5 negative sentences), all negative (5 negative sentences), and no response. Findings revealed

41 all positive responses, 49 mostly positive, 4 mostly negative, 0 all negative responses, and 3 no responses. An analysis was made of the negative comments categorized as mostly positive and mostly negative. Here, 16 participants felt the project was time consuming; 16 felt the project was expensive; 11 became frustrated using the computer; 9 wanted more structure; 7 found the assignment stressful, tedious, difficult, demanding, or tough; 4 perceived the process as a lot of hard work; and 3 felt that using the writing process was tedious. Other individuals reported difficulties with specific components of the assignment. Specifically, problems with the hardware (no color printer, difficulty with camera) with personnel in the computer lab or the public access to children's photographs.

The preservice teachers indicated that this assignment was valuable, both in its approach to teaching computer technology and literacy processes. An added benefit was the personal motivation for these novice teachers. The participants were asked to report on how they shared their stories, and others' responses to the LESs. Here, the positive comments were overwhelming, with most stating that they were great, cute, super, educational, creative, funny, or priceless. Finally, most of the participants (88.66%) indicated that they planned to create an LES with their future students. The remaining participants indicated iMaybei (6.19%), iProbablyi (2.06%), iNot Surei (2.06%), and iIt depends on the grade I teachi (1.03%).

Conclusions

Since the LES project increased preservice teachers levels of comfort using the computer, computer technology skills, and understanding the writing process in education, it was concluded that it was a beneficial assignment. In addition, 87 percent of the preservice teachers planned to share and 89 percent planned to create LESs with their future students. It was also concluded that the LES project should be continued in future sections of EDRD 350 Computer Technology and Reading Instruction. Based upon student feedback, a computer trouble-shooting component will be added to the class. Future additions to the assignment will be the development of online LESs, with publication on the Internet.

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Adapting Computer Software to Address Specific Needs of Problem Readers

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Literacy Instruction has changed radically in recent years based on changing theories of how learning takes place. Teachers have incorporated ìwhole language,î ìwriting process,î and ìliterature basedî instruction in elementary classrooms to replace previous literacy programs that relied on basal readers and a focus on skills/subskills. This change is reflected in the recently published Standards for the English Language Arts (NCTE/IRA, 1996), which advocate new roles for teachers in the language arts classroom. These new standards have also expanded the definition of language arts from the traditional areas of oral language (listening, speaking) and print language (reading, writing) to include a third area of media language (viewing, representing). Thus, leaders in the field of language arts have acknowledged the profound influence of new computer technology tools on the teaching and learning of language in elementary classrooms.

There is a need for a similar change in the role of reading specialists. The advent of advanced computer technology and the development of a new generation of computer software programs has heightened this need. New forms of assessment are now available, and are becoming available on computer software (Hasselbring, Goin, Taylor, Bottge & Daley, 1997; McEneaney, 1992). New versions of literature such as interactive storybooks and writing tools such as children's versions of word processing have implications for teaching reading comprehension and writing composition. Other new software programs allow drill and practice on supporting subskills for reading and writing (e.g., word recognition, word meaning, spelling, punctuation, grammar) in entertaining formats such as interactive computer games.

There are, however, practical problems with using software for teaching. Unsupervised learning, even with complex software, may not be educational. Students ìplayî just for entertainment in interactive storybooks (Matthew, 1996) and fail to learn new words by attending to the print that accompanies the ìplayî setting. They work with skill and practice software by ìtrial & errorî instead of thinking and using strategies, thus focusing on ìwinningî rather than learning.

Teachers must therefore tailor software use and practice to specific needs of struggling readers and writers. They must first identify needs, select specific software to fit those needs, then supervise closely as students interact with the software. They must monitor and coach, and evaluate with observational checklists in different types of literacy software.

One role of the reading specialist in an elementary school is to provide a ìsafety netî for those students who have difficulty in literacy tasks in the regular classroom. This can be accomplished more easily with technological tools now available. Reading specialists who are familiar with software programs and ways to tailor their use can help classroom teachers provide specific instruction beyond ìpull outî and ìpush inî or inclusion times with struggling literacy learners. For this reason it is important for teachers who are working toward the reading specialist certification to gain experience in working with elementary children as they use computer software.

Program Description

The Summer Reading/Writing Program (SRWP) conducted at Eastern Kentucky University for the past three summers involves experienced classroom teachers who are completing state certification as Reading Specialists. Elementary students in the program are identified by their regular classroom teachers or by parents as needing additional help in the reading/writing process. The program is an intense five-week program in which teachers spend two and a half hours each day with students either individually or in small groups. Over a period of three summers, a total of 32 teachers and 95 students in grades one through eight have been involved in the program. Teachers have used a variety of instructional strategies and materials under the supervision of a university professor who specializes in the field of language arts. The focus has been on creating a rich whole language environment and on engaging students in actively read, writing, listening, speaking, and thinking. A workshop format, along with language arts games and learning center

activities, has been used to allow individuals conferencing and tutoring time.

Computer technology has been used in all phases of the program from initial diagnosis of developmental levels of literacy to remediation of reading/writing difficulties. Several software packages have been examined and evaluated for use in the program. Two software packages used in the area of diagnosis were Assess A and Assess B. Software used for reading included Living Books, Accelerated Reader, and for reading skill development, Spell It 3 and Word Attack 3. In the area of the writing process, Storybook Weaver, Student Writing Center and Read, Write, and Type were used.

Teachers in the program used the software initially as prescribed within the manuals. However, the lesson plans and materials provided with the software were designed for general classroom usage. They included thematic unit connections and activities for a variety of content areas as well as general suggestions for reading, writing, and skills development. Teachers in the program found themselves sifting through the support manuals looking for activities designed to focus on specific needs they had identified. They found that they needed to design their own specific ways to use the software in order to meet the needs of the struggling readers in the SRWP. As they became more familiar with individual student needs and with the capability of the software, they adapted the software usage to better fit the needs of the particular students. Four programs in particular seemed to lend themselves to use in this way. The following discussion outlines specific techniques designed for students using these four programs.

Models Developed for Specific Use

At the end of the program, teachers reflected on their experiences and described some of the specific adaptations used and the effectiveness of each adaptation for particular needs. The four programs used most by the teachers were Living Books, Storybook Weaver, Spell It 3 and Word Attack 3.

Br¯derbund's Living Books are designed to allow primary level students to listen to a book read aloud as text is highlighted on the screen. Students can play inside each page of the story by clicking on objects in pictures to see and hear animated characters do a wide variety of things. Students can also choose to click on words to highlight and hear them read aloud, and to hear and see the text in English or Spanish. The teachers reported that they adapted the Living Books program to help primary students with word recognition and comprehension. Students used the software with partners to do choral reading and paired reading in order to develop reading fluency. Teachers helped them develop comprehension strategies through guided reading activities such as making predictions and asking comprehension questions. They helped them develop word recognition skills by having them locate specific words or words containing specific phonic elements. A good technique that emerged was to require the students to do the iread to mei mode before they were allowed to switch to the iplay inside the storyi mode. This encouraged students to focus on comprehension of the story and on reading along with the highlighted and spoken print rather than on the animated features. Teachers monitored these readings and enhanced comprehension by discussing stories with students before, during, and after readings. They also paged back through the stories to highlight a variety of sight words, phonic elements, punctuation, and the use of context clues to predict words and strengthen students' use of word recognition strategies.

MECC's Storybook Weaver Deluxe CD is designed for students age six to twelve, and allows students to create their own interactive storybooks with title page, text and illustrations. It has text to voice capability so that students can have their stories read aloud by the computer. Students can design illustrations using choices of background, foreground, objects which can be made larger or smaller, and can be given sounds and changed in color. Teachers found that this program worked well with primary students as a tool for invented spelling. This specific usage developed phonemic awareness and phonic skills. Especially useful was the feature of this program that converts text to speech. This feature allowed students to identify misspellings by hearing words pronounced the way they were written. Other ways teachers adapted this program were to have students create story maps before writing and use teacher created story starters based on specific student interest.

Two programs used extensively by teachers in the program were Spell It 3 and Word Attack 3. These programs were designed to focus on spelling and word meaning, with choices of ability levels ranging from primary to adult learners. Spell It 3 consists of a choice of game formats that present words in meaningful context, apply spelling rules, distinguish between correct and incorrect spelling, develop short term recall of spelling words, and develop editing skills for identifying errors. Word Attack 3 also has a choice of games formats designed to develop meaning vocabulary using context clues and dictionary definitions. Older students seemed to gain most by adaptations of the two programs. Teachers developed individual word lists based on analysis of student work samples. The computer programs then generated game activities to develop spelling and word meaning from the word lists. Types of word lists based on grammar were also used (i.e., nouns, adjectives, verbs). Students enjoyed working with a partner and prompting each other for specific strategy use.

Conclusions

Beyond making gains in the specific reading skills outlined above, students acquired competencies in the computer environment. For example, they became adept at using the keyboard, finding and clicking on particular options on the screen, and finding favorite pages in a book.

In the process of using the computer packages, they learned specific sight words such as quit, stop, options, restore, close, yes, and no.

Teachers gained confidence in their ability to tailor available software to specific students' needs. They discovered ways to exploit peer teaching by having students work in pairs at one computer or in small groups using one computer program under close teacher supervision.

The adaptations of software usage designed by these teachers should continue to be refined. Research is needed to determine and document the effectiveness of each technique. However, the potential uses of technology for struggling literacy learners are highly promising. The teachers in this program have shown that creative adaptations for specific needs of students are effective as well as motivating.

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The Reflexive Evolution of Technology in Literacy Courses for Preservice Teachers

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These are exciting but challenging times for teacher educators. As we strive to prepare teachers for the twenty-first century, we are confronted with both the public's anticipation and fear of the rapidly approaching third millennium. Many educators have heard the voices of the business sector concerning the quality of future workers, who must have the appropriate skills and the flexible creativity to function in a post typographic world (Boyette & Cohn, 1991). The recognition that future students and teachers must be proficient in technology prompted the institution of basic computer classes within teacher certification programs throughout the country. The evolvement of these courses over the past decade has been exciting, and with the advances in hardware, software, and the limitless possibilities of the Internet, many educators anticipate the positive direction of teacher preparation. Regretfully, along with this anticipation, a critical public also voices fearful concerns about the literacy levels of our students. Witness endless newspaper articles and list-serv dialogues that again raise the ageless battle cry for phonics first instruction, correct spellings, even in young children's first drafts, and the dissonance between college professors' ideals and the real world. In a pre twenty-first century world where a strong economy prevails and no major wars dominate the evening news, it is not surprising that legislators in several states promise changes in state curriculum and in colleges of education, particularly in the area of literacy, and changes that are not particularly progressive in nature.

The challenge for educators then, is to establish teacher preparation programs that are innovative, progressive, and are successful. Such changes must not be made because the legislators demand it, or because ichange is good.î These arguments are no better than the premise of traditionalists that change is not needed because iit has always been done this way.î What is needed is a reflexive evolution of programs. This process requires the participants to reflect upon the events and to make changes, or not to make changes, based upon that reflection. This reflection is influenced by a number of variables including the students, the site based context, knowledge bases, belief systems, and political and economic factors. As the rapid advent of technology has increasingly played a critical role in the professional development of teachers, it is important to review the use of technology within methods courses. Through such a process, university professors can better plan courses for preservice teachers, courses that include technology within authentic contexts, rather than to use technology for technology's sake (Connell, 1997). The purpose of this study then, is to examine the evolvement of the use of technology within a preservice teacher literacy course. Specifically, the study focuses on the reflexive evolution of the use of technology in Reading and Language Arts in the Elementary School during a three year period (1994-1997) as it progressed from a one hour traditional campus based course to a three hour field based course.

The Milieu, Course, and Method

As this course evolved from a one credit university based course to a three credit field based course, several changes have occurred. In the fall of 1994, preservice teachers at the University of Houston were prepared for elementary classrooms in a very limited way. Due to previous Texas legislation, education courses were limited to 18 hours, relegating only a third of those hours to methods courses. This resulted in a one hour language arts class which met four hours each Monday morning for five weeks. The course was also taught at the university, and offered no opportunities to work with children. In the following spring, the course was field based, allowing opportunities to work with children, and met for the entire semester; however, students still received only one credit. The following fall (1995), with the sunsetting of the previous legistatation, the course was combined with a three hour reading course and was field based along with science, math, and social studies methods. It remains part of the PUMA (Pedagogy within Urban Multicultural Actions) today. In the current context, students are assigned to a cluster that is determined by the

students' request for elementary or middle school setting, or by geographic areas. These site-based environments have provided opportunities for students to practice theories of learning in public elementary and middle school classrooms under the supervision of both university and public school teachers. Consequently the preservice teacher is at the elementary/middle school site on a daily basis and becomes a member of that elementary or middle school culture.

Approximately 25 students are enrolled in each of the six clusters and are in their last semester before student teaching. The classes are representative of the students within the college of education; they are predominately female, white, and are in their early twenties. Several students are male, African-American, Hispanic, or Asian, and may be older students seeking a career change. They also vary in their area of specialization, (reading, early childhood education, health, math, bilingual education, history) and in their familiarity and access to technology. While many of the students own or have access to a computer in their home, others have limited access to computers and may have only basic understandings of technology.

The reflective inquiry was structured by using Smyth's questions (1992) as a framework for critical reflection: 1) Describe- what do I do?, 2) Inform- what does this mean? 3) Confront- how did I come to be like this? and 4) Reconstruct- how might I do things differently? Specifically, the questions guiding the analysis were: 1) How have class activities and assignments regarding technology changed as a result of the evolvement of the course?, 2) How will these changes impact the future of technology assignments within a field based course?, and 3) Will these changes encourage preservice teachers to utilize more technology in their future classrooms?

Using syllabi, course materials, and data collected from previous studies, (Matthew & Williams, 1994; Williams & Matthew, 1995; Williams, Tyson, Hilton, Kimbell-Lopez, & Granger, 1997) I completed a grid listing all the technology assignments made in the course from the fall, 1994, through the fall, 1997. Other artifacts from the course and the previous studies were also analyzed, including survey questions and field notes about student presentations and interviews. A reflexive narrative (Ruby, 1989) was then written to document these changing decisions. Finally, the data was compared to determine the evolving trends of technology within this field-based course.

Findings and Conclusions

The assignments regarding the use of technology changed greatly over the past three years. When the course remained on campus, one of the major concerns that the students raised was the lack of classroom experience. They voiced interest in the writing abilities of elementary and middle school students and were curious about developmental spelling in young children's writing. As a result, a HyperCard program, Stages of Children's Writing Development (Williams & Matthew, 1994) was developed. This software was used on a weekly basis during class time in the computer lab. In this assignment, students worked in pairs to review the stacks which coupled literacy research on early writing with authentic examples of student writing. After the students spend time navigating the stacks, they were to analyze a sample of student writing, offering suggestions for teaching.

During the following semester, students were field based and did not have access to a computer lab. In the infancy stages of the PUMA program, there were few computers that were designated for university students' use when they were at the elementary school site. Through the use of a laptop computer, I was able to bring the HyperCard program to the site where students interacted with the program during a workshop approach. Due to the limited availability of computers, the assignment was not graded. By the following semester, progress had been made regarding the access to computers. The site where I taught had a power Macintosh and a printer. An LCD panel was promised, as was internet connections. Along with the laptop computer, I was able to continue using the HyperCard stack as an assignment, along with the presentation of educational software programs. Again, time and access to multiple computers prohibited the effectiveness of using this technology assignment as a grade. By spring 1995, we had been connected to the Internet. The HyperCard program was again used as a class activity. However, due to the added opportunities of working within authentic contexts, the students were now engaged in literacy events with elementary and middle school students which provided them with more authentic understandings of students' abilities as writers. It became apparent that this program was not as effective in a field based course.

Prior to the start of the fall 1996 semester, the entire PUMA faculty was informed that each site now had a designated computer and was challenged to incorporate more technology into the curriculum. The five instructors for Reading and Language Arts in the Elementary School met to discuss the development of a common syllabus, and how to integrate technology into the course. Although we were all proficient with technology, our abilities and experiences varied. As we all recognized the changing and differing needs of our students, and held a constructivist belief about teacher preparation in general, and in computer literacy specifically, we decided to assign a technology project. This assignment allowed the student to create teaching materials, or to plan and implement literacy events with their students, that would require the use of technology. We provided class time for students to work together, to have access to the computer, and to share ideas through a process approach. The students defined technology to include computers, videos, and audio tapes. We continued this approach for the spring semester. During both semesters, students were also exposed to technology through mini-lessons, "surfing the net," and the examination of software.

As this course has evolved, the use of technology has indeed changed. When the course was limited in time and place, the controlled assignment fit the needs of the students nicely. Lacking opportunities to observe children engaged in the writing process, they were happy to have the vicarious experience through a primitive virtual reality. As students became more involved in truly authentic field-based activities, the need for the information contained in the HyperCard diminished, and the need grew to develop literacy materials that could be used in the classroom. This was evidenced in the quality of their assignments, and in the nature of their comments. When the class was held on campus, the students enjoyed navigating the stacks, and did a good job of analyzing the student writing samples. They lacked the enthusiasm, however, that the field-based students had when they presented their technology project in class. These students were allowed ownership over the class assignment. They created innovative big books, software programs, and other teaching aides that were professionally constructed. Overall, students in all sections of this course enjoyed using technology as a means of learning about the literacy events of elementary and middle school students. However, some students were hesitant about using technology. Although students' computer proficiency increased over this three-year period, some students still turned in hand written assignments, and were reluctant to take a leadership role when working with technology during class activities. Students who had computers at home, for example, tended to submit class assignments complete with graphics, decorated computer paper, and wrote longer, more thoughtful comments. They appeared to have more pride in their overall work when compared to students who submitted handwritten assignments, complete with misspelled words, incomplete sentences, and an overall lack of professionalism.

As teacher educators progress in the preparation of tomorrow's teachers, it is critical to incorporate technology within authentic and reflexive experiences, despite the difficulties faced when moving courses from the university to field-based settings. The opportunities that these elementary and middle school settings offer preservice teacher as they transfer from student to teacher are priceless, but many of the amenities that afford the university student may not be available to the average elementary and middle school teacher; despite the national cry for equal access to technology. Many universities may have the necessary equipment and teaching materials to illustrate the potential for using technology to engage students in literacy events. Therefore if preservice teachers are encouraged to use technology within the confines of the university, but are not able to use it during their field based experiences, it is unlikely that they will continue the practice as inservice teachers. Based on the premise that that technology is best learned and appreciate when implemented within authentic contexts, it is essential that technology continue to play a pivotal role. From this self-reflection I have discovered that the most effective use of technology is determined by the educational context. Given the university setting, where experiences are limited, the structured format provided the students with an image of literacy development of elementary school students. Once in a field-based setting, students do not need to be provided with this image, and consequently, such assignments are not meaningful. Allowing the students to have a voice in their control over the implementation of technology not only assists them in the development of meaningful teaching materials, but also provides them with the opportunities to become more proficient in the use of technology. Finally, it models for them, the way we would like them to teach their students. Therefore, as this course continues to evolve, based upon self reflection and oral interactions with other reading and language arts professors, as well as the other methods teachers involved with the PUMA program, I intend to continue using technology both in class presentation of materials, and in assignments. It is only through such constructivist approaches that preservice teachers will become more comfortable with using technology as an integral component of planning literacy events for elementary and middle school students.

Finally, students in this course have expressed the optimism that they will also use technology in their own future elementary and middle school classrooms. This information is encouraging, given the limited exposure to computers that they experienced during their field-based assignments. As these new teachers enter the next millennium, they are becoming far more prepared to teach tomorrow's children through technology. Hopefully, they will meet the challenges that are being made by today's society, and that they will be equipped to prepare their students to be literate, flexible, and creative, allowing them to be productive in this new post typographic world.

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TEAM EFFORT: A CLUSTER OF SHARED INITIATIVES

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Harley states, "Collaborative working is pervasive in our society, indeed, society can be conceived as an organization to assist the utilization of our respective knowledge and expertise. Hence, collaboration occurs within a social context, . . ." (1996). Collaboration between inservice teachers and preservice teachers is crucial to enhancing school children's learning and teachers' professional growth. However, effective management of this instructional method is complicated by the high level of social intelligence required to work in a group. A successful collaborative endeavor rests heavily o the structure and organization of the instructional model, and the shared initiatives of the participants. Further, since cdlla-tive work can often make the impossible possible, one must spare no effort in realizing successful collaborative ventures.

Classroom Problems

In their 1992 book, Modern Elementary Curriculum, Shepherd and Ragan discuss the mainstreaming of all students into elementary classrooms, including students with learning difficulties. A gap between needed services and available funds resulted in the Regular Education Initiative (REI), a proposal from the US Office of Education. This policy has initiated a reexamination of the delivery system for special education with an emphasis on the least restricted environment and equal educational (Shepherd & Ragan, 1992). REI assumes that: a) students are more alike than different, b) good teachers can teach all students using the same basic techniques, and c) all students can be instructed and managed effectively in the regular classroom.. However, many inservice teachers have expressed concerns and frustrations in meeting the various needs of students ranging in intelligence and social behaviors.

Models of Collaboration

One highly successful model of collaboration often used in the classroom is that of peer interactions. Based on the work of Piaget, who argued that children greatly benefit from coordinating their thinking with that of their peers (Piaget, 1928), many teachers promote collaborative modes within their instructional framework. Although many studies report the advantage for learning within peer interactions, iother research has suggested that young children do not engage easily with the demands of academic collaborationî (Crook, 1995, p. 542). These observational studies of informal class groupings indicate that pupils may not readily or deliberately adopt collaborative modes of working. iIn practice, such work may proceed more as a cluster of parallel initiatives among the participants, albeit initiatives converging on a shared goal.î (Crook, 1995, p. 543). Given the findings of this research, we should not become overly discouraged, and therefore dismiss the use of collaborative learning, but rather consider ways to assist young children to master the process. According to Vygotsky's zone of proximal development, individual learning is mediated through either iadult guidanceî or icollaboration with a more capable peeri (Vygotsky, 1978, p. 86).

Thus, it is reasonable to conclude that the limitations of peer collaboration may be overcome by guidance provided by mature, capable and motivated adults who practice recent academic advances. In particular, Collaborative work between inservice teachers and preservice teachers, together with the help of technology, shows great promise in helping to address these concerns. Indeed, technology has already begun to provide means for creative and individualized instruction for the full academic and social range of students, without sacrificing the general curricular requirements of the class as a whole.

Recognition of Possible Assistance

As state and federal regulations forbid students to remain in classrooms or in computer labs without adult supervision, the necessary individual instruction becomes more complicated. Many schools approach this problem by putting a few computers in the classroom. This allows some students to work individually, while the teacher is free to meet the needs of the rest of the class. However, this is more an iexpedientî than a isolution,î as the mere presence of the teacher does not automatically guarantee individualized student instruction. In addition, because many inservice teachers lack adequate technological literacy, and are constrained by multiple class preparations, the problem of designing individualized instruction integrated with technology becomes acute. Given this context, the possibility of LD students receiving efficient classroom instruction through technology is minimal.

Experienced supervision for students in the technology rich classroom is not limited to young students. Preservice teachers, although eager to be in the classroom, often lack a clear understanding of planning and implementing authentic learning events. As teacher certification requirements in Kansas include more than 100 hours of classroom involvement, preservice teachers are provided with opportunities to assist inservice teachers. Regretfully, all too often, these experiences are simply empty hours. This may be the result of inappropriate communication among the college supervisor, the classroom teacher, and the preservice teacher. The purpose of this article is to present an outline for a more highly structured environment which allows for better communication among the participants in teacher preparation.

Project Design, Procedure and Logistics

A specially designed collaborative learning project patterned on the "Vygotsky's zone" model (Vygotsky, loc. cit.), was carried out in an elementary school. Participants included an inservice teacher, three preservice teachers, the author (as an educational technologist), and five LD students with written language deficits. Using a computer program, the major goal was to help LD students develop writing skills. A sub-goal, however, was to provide preservice teachers with experience using computer technology, especially as it applies to providing individualized instruction to students with special needs.

This year long project was motivated by a fifth grade teacher who was struggling to teach writing skills to mainstreamed students with written language deficits. The proposed solution was to augment the instruction with technology; yet there remained at least two logistical difficulties: (1) finding appropriate educational software, and (2) providing supervised computer instruction, thereby conforming with state mandates. To address these difficulties, free software, which had been used successfully in the past with LD students (Zhang, Y., Brooks, D.W. Frields, T. & Redelfs, M., 1995), was introduced to the participants. The three preservice teachers were then recruited and instructed in technology and techniques of providing writing opportunities for these elementary school students.

Using this software, the fifth grade teacher redesigned a writing curriculum which included three 20 minute periods per week for the participating LD students. During this time, they practiced writing using computer technology in a supervised lab. The students engaged either in either free writing or composing according to a specific topic. Most of the assigned topics centered on issues related to their personal experiences. At all times, at least one preservice teacher worked with the LD students. Most of the time there were two or even all three preservice teachers in the lab, working one-on-one with the LD students. They helped them to recognize the potential of using computer technology to improve writing skills, and motivated them to help offset occasional periods of frustration The author supervised the process, served as the technical advisor, and facilitated communication among the participants of the project.

Computer Program

The software selected was ROBO-Writer, a HyperCard stack developed over a three-year period through a close collaboration between classroom teachers, students, researchers, and software developers. The objective of this software program is to assist beginner writers and their teachers. (Brooks, D.W., Zhang, Y., Frields, T. & Redelfs, M., 1994-1995). HyperCard is an application for the management of small amounts of text, graphic, and sound information. It can be used to create and store words in clickable lists. ROBO-Writer has four features that make it especially active for writers with learning disabilities in primary grades. There are carefully designed, teacher editable lists of words arranged alphabetically; oral feedback is provided; words selected from internal lists as well as those typed in as free responses are pronounced. Nearly all the features are icon-driven; aural help is provided for all student-used features. This free software is available at the sight of http://www.cci.unl.edu.

Benefits for Preservice Teachers

In preparation for this project, the participating preservice teachers engaged in a pre-project preparation session. They become familiar with the computer software and the purpose of the project. They were also apprised of the special needs, including backgrounds, and current academic performances of the LD students mainstreamed into the classroom.

The experiences that the preservice teachers gained during the process varied widely as they differed in technology backgrounds, personal interests, attitudes and identification with the project. In order to document these differences, the participants were invited to record their experiences and perceptions in a journal.

One preservice teacher believed in the whole child philosophy, was technically proficient, and was ready for the challenge that she was to face every time she worked with the LD students. She maintained frequent communication with the author, expressing concerns, excitement, and discussing effective strategies. In her journal entries, she noted a keen appreciation of the real and potential applications of technology in the classroom; furthermore she felt that she had developed a variety of valuable skills in working with young students who have special needs. She provided individual instruction in writing, and tried different motivational strategies for prewriting, and for staying on task. She expressed appreciation for the opportunity to work with students in a real classroom setting and the valuable experiences gained through the process. However, one of the three preservice teachers was not very enthusiastic about his involvement. His participation in the project was merely to

fulfill the 20 hour field experience requirement. His journal entries revealed a general lack of interest in the project even though he did carry out his portion of the responsibilities.

All three preservice teachers responded to a follow-up questionnaire with positive reflections about the program, the project design and the process as a whole. They learned to perceive the impact and potential of using instructional technology, and to be more analytical about selecting technology. Additionally, they responded positively to working with mainstreamed students. They indicated that they better understood LD students' special difficulties, and learned to try different strategies. The most beneficial outcome for these three preservice teachers was that they experienced real challenges within a classroom setting. They all felt that the structured, task oriented project was very important in assisting them to become a well prepared professional, and superior to classroom observations.

Discussion

By the end of the school year, all the participating elementary students gained a sense of self-confidence and heightened enjoyment in writing. Specifically, they learned to express their feelings in writing, and were able to better identify their strengths and weaknesses, and were able to cultivate individual differences.

The findings of the present collaborative project indicate that: (1) the students themselves saw great improvement in their writing skills, and (2) the preservice teachers were afforded a hands-on training experience. It is anticipated that through such project, preservice teachers can not only experience authentic classroom experiences, but also assist the literacy development of elementary school children.

Conclusion

This project further documents the emerging importance of technology at all levels of education. Furthermore, it establishes two levels of collaboration. The first includes a mentor, an inservice teacher and preservice teachers and leads to an effective and structured model for teacher preparation. The second level involves collaboration between the students and the imore capable peers,i which leads to enhanced student performance. Indeed, we feel encouraged by the fact that through this structured environment, students with a variety of disabilities were able to engage in collaborative behavior.

Finally, while this project is not intended to be a specific blueprint for a collaborative model, we anticipate that it will guide other models. We hope that it has helped to isolate, amplify and analyze those aspects of team cooperation.

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Elementary School Children Exchange Information about Environment: Reading, Writing and Knowledge Organization

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In the most common school practice students (and teachers) are seen as consumers (and transmitters) of culture. A factor of dis-equilibrium in such a system is introduced when students (and teachers) become involved in the production, accumulation, and circulation of ideas that can be eventually appropriated or critically rejected by other members of the community, as it is the case in the scientific community.

An external audience constitutes a powerful "constraint" to the class practice: a) it questions the social value of the outcomes of the activities, to select what to make public, b) it requires argumentation, c) it creates awareness of alternative ways of pursuing the same goals, d) it demands confrontation with other standards of validity and of quality, and e) it makes one more responsible and proud of one's own achievements since they become shared resources. Based on these assumptions, we designed an educational context where the software Our World is a component.

Educational research is making significant progress in the comprehension of the principles which can guide the teachers in the organization and management of communities of learners (Brown & Campione, 1996; Lamon Secules, Hackett, Bransford, Goldman, 1996; Ligorio & Caravita, 1994; Scardamalia, Bereiter, & Lamon, 1994; Salomon, 1993). Consistently with the socio-constructivist theories, these studies have confirmed that action strategies, thinking strategies and communication strategies depend on one another for their development and growth, and require a social context. Recursive elaboration is motivated by the circulation of products in a community where expertise is distributed and where products must be integrated in order to achieve a higher level of complexity.

Written Composition and Knowledge Organization

In school, the students comply with their teachers' requests and write reports to demonstrate that they have actively participated in their class activities and have achieved learning goals. Text composition is intended for the re-production of knowledge (content knowledge, performance skills).

The school reinforces the idea that to write means to use the correct words, rather than to learn how to use one's own words; it does not suggest that words are schematic approximations of comprehension, which can be continuously readjusted along with the changes of meanings produced by situated interpretation and communication. No wonder, then, that evidence from several studies indicates that students of any age lack the abilities that expert writers use, such as the ability to plan and of revise texts at a deep level (Beach & Bridwell, 1987; Bereiter & Scardamalia, 1987; Hayes, Flower, Schriver, Stratman, & Carey, 1987; Piolat, 1988).

The purpose of our research project is to determine the extent of the development of these abilities (even at early ages), when the educational environment creates the conditions for the students to exchange meaningful, informative documents within a community larger than their class. In the learning environment that we are observing, collaborative writing and class discussion are viewed as effective situations that support children in cognitively demanding tasks such as producing informative texts for external readers, revising them, and evaluating documents produced by other children (Keys, 1994). We are monitoring these processes and their influence on knowledge organization. We are also wondering about the status that peers vs. adults

may have as information sources. Additionally, do children see documents produced by peers as worth reading and useful to their work.

Environmental Education and Information Exchange

An important goal of Environmental Education (EE) is to make students aware of the many components, variables, and constraints that shape every environment in which we actively and passively participate and to promote questioning about this interplay. The software Our World invites school classes all over Italy to contribute the outcomes of their explorations in the environments where they live to a library. The sharing of this resource makes comparison possible: children are confronted with the many ways of viewing the environment when the contexts are different and when people take different approaches. Emotions are involved when children can feel that they are entitled to interpret their environment and when they realize that they share similar experiences and questioning with others. Private experiences get transformed into objects that can be shared in social interactions. Essentially they take the features of information. Information is not an entity but it emerges and it is defined within the sender-receiver relationship in specific systems, in finalized contexts.

Method

Our project fits into a nation-wide project sponsored by the National Department for the Environment (Italy). It is currently taking place in a group of elementary schools in Rome and in three other towns. The software Our World provides the students with the organized structure of a database where they can store their documents; its very friendly pictorial interface facilitates the documents retrieval but it also conveys messages consistent with the ecological domain. The documents filed in the library are written texts which may be accompanied by images. Contributors are requested to follow simple editing rules and to submit their documents to an editorial board which is responsible for the database implementation and for sending feed-backs to the authors.

The library is split into five databases labeled as: Phantasy, Research, Law, Publishing, Institutions. This subdivision suggests that a range of approaches are possible when dealing with environmental issues and marks the difference in content and literary genre of the outcomes of the investigations. We are now working on a new version of the program for the Internet, that will allow communication among schools and other territorial institutions.

The pedagogical guidelines discussed with the teachers provided the following activities:

a. integrating writing with the inquiry activities (taking notes, keeping drafts, using metaphors, summarizing protocols.....) and the with the construction of knowledge;
b. fostering reflection on criteria for selecting ideas when the class is engaged in writing documents addressed to an external audience (informative, original, argumentative, ...) ;
c. calling attention to the rhetorical features of the text, in the respect of personal expressive modes; d) supporting revision by modeling interventions on the text's structure and cohesiveness; e) promoting critical reading of documents retrieved from the database; and f) integrating this kind of information within the class work.

The data presented here concern critical reading. It has been collected in five 4th grade classes that we are monitoring. The documents submitted to children's attention dealt with environments which had been investigated by the readers. They were presented as documents received by the editorial board to be evaluated and filed in Our World. Paper copies were handed out and children read them silently before engaging in a class discussion which was audiotaped. Discussions lasted one hour or more.

Results

The class discussions that followed the reading of the documents were very lively and engaging. For the teachers also, who expressed positive remarks on this activity which was quite new to them: they underlined how insightful it had been for addressing significant contents of EE and how it might improve children's ability of composing written texts.

In each class the discussion was started with questions about comprehension, such as: "Do you have questions about this document? Did you find something that you did not understand?"

The majority of children's questions had to do with the clarification of words' meaning; words or expression which were not familiar to them (in some case because they had a regional connotation), local names identifying places, scientific names of plants and animals. The informative value of difficult words and in particular of scientific terms has been a controversial issue in almost all the discussions. The conflicting views can be summarized as follows: a) when you do not know a plant or an animal, their scientific name does not help you to identify them when you explore an environment; if you find them mentioned in a text you expect to understand which kind of plants and animals they are from the text itself; and b) if you do not know the scientific denomination you cannot retrieve information or pictures, you cannot search on vocabularies or manuals.

The suggested solution was that scientific denominations should be accompanied by short descriptions in parenthesis, or as a note, for example, "otherwise children who live in town.... how do they know!" This is helpful and might enhance the motivation to look for more information or for the animals and plants themselves; "you might want to check if the description is truthful."

The counter-arguments were that the text might become too long, might be boring, and/or it might loose focus. Here the students remarked: "the discourse cannot deal with too many issues, you must select", "if you describe the whole country and then you end up not talking about the topic you had chosen.....then you lost what was important!!!"

Additionally, students were concerned about understanding words imbedded in the text. "Difficult words are understood when you read further on in the text". Finally, few children raised issues concerning the clarification of claims in the text. In these cases their remarks originated from the experiences that they had carried out in the class, which suggested discrepancy of observations, or the need of more details.

Text relevancy was then discussed with the children. They were asked whether the document that they had read was interesting to them and why. The texts were valued as interesting in all the classes. Children offered a wide range of pertinent arguments which revealed an attentive reading and which are significant for assessing the educational value of exchanges among students. The judgments, however, were not unconditional. Trivial information was detected and limitations were also put into evidence. In addition, children appeared to be sensitive to the age of the authors. We exemplify here the main types of justification that were expressed.

"it is important, it is written by children who live there, because they know better, they can describe the place in a way different from what you can find on books, even easier to understand.....perhaps. Though, if you search on books, probably you find the same things that they also have written"

"it helps you to know new words; they have used the right terms.... we did not know them, then we have asked you and we now understand their meaning"

"it helps you to understand the life of their school, what is alike between our school and theirs"

"I did not know anything about newts and here it is well explained"

"it can be useful because we can work and discuss on similar things"

"the text is effective but I am not interested in the content.....every person knows that already"

"we should not forget that the authors are second grade pupils: they have done even too much!"

Through effective questioning the adult who was leading the discussions was able to evaluate the content of the documents and to identify their informational core. In this respect, we must also take into account the peculiar features of these texts. They had been produced by non-expert writers and the textual structure did not always make clear the relationships between the main focus and the additional comments. This part of the discussion was introduced with a set of questions such as: "What information the authors wished to communicate with this document? What is the main subject? Can you guess an outline that these children followed when they composed the text?"

It was evident that these issues were at the edge of the fourth grade students' ability as critical readers (the inference of the outline in particular). Some children were more skillful than other ones in dealing with them. In general, the title of the document was used as the main cue for answering. The lack of consistency between title and content of one text was pointed out by two classes. Some children focused their attention on descriptive details or on the narrative component and were not proficient in extracting the core content of the message. Some children added personal interpretations. But interesting statements such as the following, called for the adult's attention and raised further discussion.

" the document made me understand that our pond is different.....very different from that in Tuscany"

" the stream is the main topic, plants are second in importance. The writers added the plants because these plants were typical of their country, so it was natural for them to specify it"

"I think that they made hypotheses about man's impact on the course of the stream"

"this text tells what our schools have in common"

" it is as if the text is a narrative at first, and is descriptive, then it starts giving more information"

"first they chose the title and then they chose what to say"

" this text treats many topics: it first lists things that get transformed in school, then it summarizes them and this makes the title"

" their outline was the image.....they saw what they talk about"

Finally, the discussion dealt with eventual changes to modify the documents. "Is any information lacking? Do you suggest modifications?" Children did not produce many responses. However, some of them were very sensible and representative of the cognitive processes that are promoted by the discussion. Expansion of the informative content of texts was proposed by some children.

"they (the writers) should have better described the difference among the two species.....how you can recognize them....they write about the colour but do not say anything on how these animals look like. By

reading the title "Newts and their environment" you expect that the authors describe just everything. We might search on the database if there is information about newts, if there isn't and we find it in books, we might file it in the database, so that everybody gets to know what a newt is"

"they have described everything....they say that they have explored the pond, but they don't tell us about their actual impressions...." "I would suggest them to add more emotion, because the sentences here are just descriptions"

" they should have given information on how to reach that place"

" they should have added whether those plants were living in the water or close to the water"

"why the park should be improved? We might ask them how they want the park to be improved. They do not tell if their park is dirty, if it needs more places for playing or if it has no grass...."

Suggested modifications mainly focused on elimination of obvious details or of places and people. These were viewed as irrelevant for readers who do not belong to the same community and as useless since they cannot be found within a universal vocabulary .

Children's comments about these textual features, brought into evidence problems very relevant to the environmental domain and offered the teacher an opportunity for mini-teaching. One of the young writers expressed concern about deciding which were the significant components of a given environment that should be included in the document. Other problematic issues were: the relationship between structural and functional dimensions of built environments and how to decide where to set the borderlines of an environment.

Discussion

Although, our data is descriptive and exploratory, we consider these initial findings promising. They are supportive of our predictions about the educational potential of the learning environment that can be created with the support of technological resources such as Our World. Children are motivated readers of peer's writings. Information produced by peers, just because it is not so complete and structured and unique, can be viewed by students as a more manageable than information contained in books. It is felt as closer in expression and in subject, it is empathically accepted, and it can be more freely criticized since its source has less authority.

The relationship between familiarity and novelty was confirmed as an interesting aspect of the exposure to informative messages. Children valued the content that could be related with their previous experiences. They were interested in the novel elements that enable them to acquire deeper or more specific knowledge related to those experiences. On the other hand, they liked to be surprised and by new perspectives. When exchanges take place among students who share final projects the many ways of perceiving, exploring, describing, modifying, and valuing the environment becomes informative.

Children appear to be critical readers and sensitive to trivial or irrelevant content. Teachers therefore must create the conditions that make the exchange fruitful. Among these the most important are: to engage the students in authentic investigations of the reality which they perceive, as they perceive it and to offer guidance in recursive processes of elaboration. This guidance enables the students to progressively obtain more significant levels of interpretation.

Collaboration among children makes possible performances that individual activity might not produce. As children write together they mutually support their cognitive work by raising questions, by offering explanations, and by modeling text processing. It was evident that the critical reading can go beyond the actual content of the text if the teacher is ready to capture the sometimes fleeting ideas that underlie tentative wording of problems.

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PREPARING READING TEACHERS FOR TECHNOLOGY NOW AND FOR THE FUTURE

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According to Strickland (1994) , "Even before they enter school, at least one-third of the nation's children are at risk for school failure. " (p. 328). Although, a number of variables such as social and economic conditions attribute to this statistic, undoubtedly, reading deficiency is a contributor to school failure. In fact, "There is no skill more basic to success in school than reading ability" (Taylor, 1994, p. 592).

Wood (1996) posits that, "As long as a third of America's public school students in grades four through twelve can't read, efforts to save the nation with flatter taxes, balanced budgets, welfare reform, more policemen, or line-item vetoes are in vain (p. 50). Therefore it is critical that teachers apply successfully what is known about teaching and learning to enhance reading instruction.

Schools in general have always been challenged over innovative instructional ideals and traditional methods (Hillerich, 1991). Reading instruction particularly has recently come under fire in many states (Harrington-Lueker 1996), partly as the result of poor test performance on national exams and national statistics on literacy generally. Consequently, an atmosphere has been created for the scrutiny of effective classroom practices.

Nature of Innovations

Technological advancements have had a dramatic impact on the design of conventional reading instruction. Technology -based networks have ignited interest and use of computer-based representations of information and knowledge (Barker 1996). In addition to traditional books and basals, these Included the Internet, electronic books, talking books, audio or recorded books, CD-Rom books, multimedia books and cyberbooks (Barker, 1996, Treiiltin, 1996; Bergeron & Bailin, 1996 ;Owston, 1997; Carbo & Cole 1995-1 Yopp 1995-, fiarritigtori.-'I,Lieker 1996-1 and Bigelow 1997). Application of these tools is supported by the fact that reading improvement can only be facilitated if schools go beyond traditional curriculum development approaches and integrate strategies that align all aspects of organizational behaviors and activities that support student improvement (Feirsen, 1997).

The most traditional pathwav to reading instruction has been through the use of narrative texts read to and with children. As more technological developments advance in terms of information sharing, communication and learning, educators need to broaden literacy development options rather than view them with intimidation (Cali-ney, 1997) Multimedia technology, for example, reflects diverse methods and philosophies of instruction that have been the pillars for teaching and learning (Cazet, 1996). Computers are now part of mainstream education (Moodie, 1995), and children are attracted to and motivated to use them in the process of learning (Guthrie and Richardson, 1995). This coupled with the documented benefits of educational technology (Van Dusen and Worthen, 1995, McCarty, 1995, Cronin, 1990, and Cazet 1996-1 Wepner, 1990) establish the basis for widespread use of technology in teaching children to read and develop literary skills.

Interactive CD-ROMs that share playful and appealing features of interactive storybooks are currently being used in reading classrooms to augment traditional instruction. These CD-ROMs include activities that address specific reading skills including phonics, comprehension, and word recognition. They incorporate animated characters, music, sound effects, color graphics, and lessons representing various levels of readability. Such programs are highly motivational and include features such as highlighted text and digitized voices to provide feedback, while enhancing visual as well as auditory discrimination skills (Cazet, 1996).

A number of software programs have been developed and published for wide spread use in reading classrooms. Oehring (]991) conducted a teacher's choice survey of software and categorized various software by subject area,and reported the teachers' favorites along with reviews and strategies for each. Allen (1995; 1996) and Cazet (1996) identified some of the most popular software used in schools to enhance reading instruction. Cole (I1997) reported on a comparative analysis of selected software for the K-3 curriculums. These programs and other interactive, multimedia programs supplement traditional printed material used for reading instruction, and have transformed instruction and the teacher's role in classrooms.

Everhart (1996) discusses six ways to use the World Wide Web to augment reading instruction including allowing students to compare and contrast two reading hour experiencesone where students select a story and read it in the traditional format, then access the same story by way of Internet to identify the differences and similarities in the traditional versus the non-traditional modality. The assumption is that because of the more interactive nature of the Internet experience, students will favor it over the traditional i-node.

In a review of studies comparing the use of conventional books to electronic books, Barker (1996) reported evidence to support the merits of using electronic books over conventional, paper-based formats. He further identifies ten different classes of electronic books including talking books, which contain audio-narrated pages of text- cyberbooks, which rely upon the use of virtual realty techniques to create simulation experiences that foster interactivity, and multimedia books, which are combinations of video, pictures, animations, sound and text.

Conclusion

Books, nonprojected technology-based tools for instruction (Heinich 1996), have been a primary mechanism for teaching and learning in educational institutions throughout the world— in schools, colleges and universities. They have been and continue to be excellent resources for reading instruction. However, contemporary investigations, based upon previous researchers, have generated innovations for the development of new paradigms for instruction (Strickland, 1994) that have great implications for the selection and use of aids for reading instruction. Consequently, dramatic technology-based instructional changes are taking place in reading classrooms throughout the country. Although traditional books will probably always augment reading instruction, current technology allows for instruction far beyond the use of conventional books.

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RESEARCH

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As computers become common place in the classroom setting, research in the field follows suit. As a result, the finding become more powerful, more noteworthy and more consistent. This year's research section of the 1998 SITE conference offers a plethora of interesting and noteworthy sections. The papers in this section have been organized into four categories for your convenience: Attitudes Toward Technology, Technology Integration, Teaching and Learning Styles, and Research.

The Attitudes Toward Technology section was broken down into three areas: preservice teachers, inservice teachers and other.

Preservice teachers

Hutchinson and Mitchell discuss the experience of preservice teacher teams engaged in a collaborative project with elementary students. The purpose of the project was to further preservice teachers' technology knowledge, provide an environment to connect theory and practice, and offer preservice teachers an opportunity to personally experience technology integration and collaboration in an elementary school setting.

Sadera and Hargrave investigated preservice teachers' preconceptions about the role of the computer in learning and teaching. Their research was based on several factors which were believed to influence preservice teacher attitudes toward computer integration.

Sheffield researched preservice teachers' basic computer literacy over a four year period. This research shows that over time the subjects' computer literacy has increased.

Stephen examined the effects of differences in teachers' and students' perceptions of computers in a fourth grade classroom.

Valmont studied teachers working with an education college and their familiarity with and use of various technologies. They were asked to comment on the level of school support related to technology they perceived and what they believed their preservice teacher education students already knew about technology and what they should know.

Inservice teachers

Christensen and Knezek explored ten subscales forming the teacher attitudes toward information technology questionnaire.

Dawson investigated the differences between the amount of money spent on computers and the way s they are typically used in instruction. They sought to identify instructional uses of computers by elementary teachers and factors that may contribute to these uses.

Kurubacak and Akbaba researched the possible factors influencing teachers' negative attutudes toward computer use in the classroom.

McKenzie, Davidson, Clay and Kirby's study seeks to validate inservice teachers' ability to obtain information regarding technology use.

Vasu and Atkins developed an instrument to assess teachers' knowledge and classroom usage of technology. Use of this instrument can result in more appropriate staff development and a corresponding increase in the effective integration of technology.

Zhao and Rop reported on a study that investigated the issue of educational applications of technology integration. This resulted in a long list of both internal and external factors, ranging from technical skills to availability of educational software.

Other

Liu, Johnson and Chandler investigated the difference in computer attitudes between American and Chinese students at four levels. A linear trend between computer attitude and computer achievement was found between subject groups.

Technology Integration

Cox-Cruey and Scollay explored a new position created in all Kentucky school districts, the district technology coordinator. A mixed methodology design was used to examine the various roles and responsibilities of Kentucky district technology coordinators.

Dirksen, Naylor, Coffland, and Bauer examined data gathered from a cross section of Idaho's school districts and teachers. They found that teachers have taken the initiative of expanding one or two ideas into a plethora of ways to use technology in their classroom and curriculum to challenge their students.

Dobson also examined a new breed of technology competent professionals and discussed how they have the power to change the world of teaching and learning.

Ekhaml, Beggs, and Ruskell explored the use of laptop computers and their impact on how teachers teach and what students accomplish.

Pan discusses his concern that inadequate involvement of teachers using technology and the lack of proper technology integration in the schools may be one reason that the use of that technology in schools has been unsatisfactory. He suggests that university teacher education programs should take the initiative to provide the public schools and teachers with the opportunities to gain technical skills and knowledge. He also addresses the issues and concerns related to this type of approach and presents his a proposal for its success.

Teaching and Learning Styles

Batchleder and Tucker examined a model of distance learning based on social constructionist principles that may help distance learners become active participants in their own learning process.

Hara, Bonk, and Angeli analyzed the use of on-line discussion and electronic conferencing discourse in two educational psychology courses. The initial findings indicated that students made use of both electronic discourse and face to face classroom instruction to create a convenient and flexible learning space.

Underwood and Cavendish discussed a teaching approach being trialled in the UK using large scale semi-intelligent teaching packages. This paper discusses the changes in social dynamics of the classroom and possible causal events leading to those changes.

Worthington and Henry examined computer anxiety and other issues dealing with teaching and learning with technology.

Research

Johnson and Liu address differences between preservice elementary and secondary students attitudes toward the subject disciplines of math, science, language, and social studies.

Jones and Paolucci discussed whether the forthcoming benefits of technology in education are still arguable.

Ropp developed an innovative approach to integrating technology into a teacher preparation course through self-regulated learning.

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Preservice Teachers Experience Technology through Collaboration with Elementary Students

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Most teacher training institutions are currently facing the overwhelming task of preparing preservice teachers for technology enhanced classrooms. There is significant pressure to graduate students that are knowledgeable about technology and equipped to use it effectively in the classroom. This paper relates the experiences of preservice teacher teams who were engaged in a collaborative project with elementary students. The purpose of the project was to further preservice teachers' technology knowledge, provide an environment to connect theory and practice, and to offer preservice teachers an opportunity to personally experience technology integration and collaboration in an elementary school setting. The preservice teachers' responses to this project were highly favorable towards collaboration and technology integration. However, these teachers also learned the obstacles they may face in attempting to effectively integrate technology as a teaching and learning medium.

Technology Training and Preservice Teachers

In recent years, teachers and teacher training institutions have been impacted significantly by the growth of technology in education, and this trend is not likely to change. The *Report to the President on the Use of Technology to Strengthen K-12 Education in the United States* (1997) suggests that more extensive and more effective utilization of computers, networking, and other technologies is crucial to the improvement of K-12 education in the United States (p. 6). In order to achieve this goal, the *Report* suggests that "teachers will have to master a variety of powerful tools, redesign their lesson plans around technology-enhanced resources, solve the logistical problem of how to teach a class full of students with a smaller number of computers, and take on a complex new role in the technologically transformed classroom" (p. 47). Yet, many teachers today still do not receive adequate training or adequate time to accomplish such mastery.

As would follow, most teacher training institutions are facing the overwhelming task of preparing preservice teachers to be technologically literate and to effectively integrate technology and their future teaching. This occurs concurrently with decreased budgets and a mandate to reduce the number of hours in preservice teacher education programs. John See, in the May 1997 issue of *The Computing Teacher*, explains that in the four phases for successful teacher training in technology, teachers must first become *aware* of what technology is available, be shown effective *applications* and see how to *integrate* technology, before they are ready to *refine* what and how they teach" (cited in Hutchinson, 1996). Institutions are thus continually challenged to restructure preservice teacher curriculums to include the necessary computer skills training and provide opportunities to apply these skills in teaching situations.

This paper will present a case study that explored the experiences of preservice teacher teams in a technology-based collaboration with elementary school students. The purpose of this project was to further preservice teachers' technology knowledge, provide an environment to connect theory and practice, and offer preservice teachers an opportunity to personally experience technology integration and collaboration in an elementary school setting.

Our goal is to relate how this experience affected the preservice teachers' feelings toward technology and its integration with their future teaching. We will focus on the collaborative efforts involving the preservice teacher teams, as well as the collaboration between the preservice teachers and the elementary students. We feel that this field experience has revealed many of the rewards and obstacles teachers encounter in the daunting challenge to fully integrate technology as a teaching and learning medium.

Background

The College of Education at the University of Central Florida has been struggling since the late 1970s to meet the challenge of preservice teacher technology training and integration. Taking a learner-centered approach, faculty have rejected "the specialized study of computers, favoring an exploration of the computer's role throughout the curriculum" (Hutchinson, 1997). Preservice teachers are

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now required to take a *Technology for Educators* course, however infusion of technology is the goal in each undergraduate course.

Funded by an Apple Partners in Education-2 grant awarded in 1995, the University and Altamonte Elementary School formed a partnership to provide technology experiences for both students and teachers at both institutions. The College of Education and the elementary school acquired a variety of technologies including Power Macintosh LC 5200's, Newton Message Pads, QuickTake cameras, color scanners, and a variety of software. One university faculty role in this continuing partnership is to serve as a teaching resource for a newly restructured K-5 program at the elementary school. The restructuring of the new program included the creation of learning communities. One community, the Vision Center, is comprised of approximately 120 fourth and fifth grade students, combined in four multi-age classes to create a "school within a school." This community provides a practicum for unique field experiences for volunteer preservice teachers.

The preservice teacher volunteers are recruited from the *Teaching Strategies I EDF 4321* course that has a field experience requirement of twenty hours volunteer work. Technology performance requirements are infused throughout the course. All class assignments must be completed on a computer to demonstrate word processing skill. In addition, students are required to learn how to use the university e-mail system, use a software package to produce a resume for their portfolios, and create a web page using HTML authoring software (i.e., Claris WebPage or Netscape Composer).

Since the grant award in 1995, several collaborative projects have been implemented between the University preservice teachers and the Vision Center students at Altamonte Elementary School. To introduce the elementary students to multimedia projects, the students created autobiographies using HyperStudio, a development program. The preservice teachers served as reviewers for the completed projects. Next, teams of preservice teachers and elementary students worked on an interactive map of the Central Florida area and electronic field trips, also created using HyperStudio. In each of these projects the preservice teachers had regularly scheduled times when they would work with their teams in the Vision Center. They enriched the resources of the public school by locating additional resources for their teams, helping to edit written work, and serving as creative consultants.

The creation of a Web page for the school was another collaborative project undertaken by the Vision Center students and University preservice teachers. Each preservice teacher worked with two Vision Center students to create a page which would eventually connect to the school's web page. Students selected an aspect of the elementary school to research, storyboard and present as a web page.

The Web Page and WebWhacker Project

During the fall of 1997 semester a new collaborative project with the elementary school was implemented. Again, volunteers were recruited from two sections of University preservice teachers enrolled in *Teaching Strategies I* (the very first course taken by all education majors) to complete their required field experience with the Vision Center students. Their task was to finalize the Web pages begun by students during the previous school year and harvest sites from the Internet using WebWhacker. Eight teams of two preservice teachers were paired with three or four elementary students. During the first half of the semester the university students reviewed web page creation with the elementary students who participated in the Vision Center projects last year or introduced the concept to new students.

A schedule was implemented to allow the elementary students to participate in the project two times during the semester by being excused from math or science classes. The teams worked at computers in the Vision Center classrooms, or out in the media center, depending on availability. After all of the students were comfortable with Web page creation, the teams began learning WebWhacker.

The goal for the experience was two fold. First, it was hoped that the Vision Center students would become the Web masters who maintain the school's Web page once it is placed on the Internet. Secondly, the Vision Center students would serve as resources for any teacher in the school who would like a site harvested using WebWhacker.

All *Teaching Strategies I* students received training in Web page development using Netscape Composer and training in Web page harvesting using WebWhacker. In addition, a graduate assistant was available for one-on-one training and guidance in both Web page development and the use of WebWhacker. Preservice teachers working with the Vision Center students also received a second workshop with WebWhacker prior to their collaboration with the elementary students.

At the end of the semester, all *Teaching Strategies I* students were asked to complete a survey designed to provide a self-assessment of their technology competencies and computer use. A section of this survey was intended to measure the attitudes of the preservice teachers towards technology and the integration of technology and teaching. In addition, group interviews were held with the preservice teachers who participated in the Vision Center collaboration, and these students also completed a separate survey that evaluated specifically their Vision Center experience.

Preservice Teachers' Responses

The overall response of the preservice teachers towards this collaborative project was mixed. The preservice teachers' feelings towards the collaboration with their classmates and the collaboration with the elementary students were quite positive. Preservice teachers also

expressed many positive aspects regarding technology and technology integration. However, the group interviews and the survey analysis revealed that several areas were problematic for the preservice teachers. These concerned organization, access to computers, the need for well defined activities for each session, and the need for more time with the students. The preservice teachers offered many helpful suggestions for revisions which will be implemented during the spring 1998 semester.

Collaboration with Classmates and Elementary Students

Most preservice teachers expressed very positive feelings regarding collaboration with their classmates. They found that working in teams provided moral support and technological support. Many of the preservice teachers began this semester with little or no computer training. They felt that having a classmate with them in the Vision Center allowed them to compare notes and ideas which greatly improved their effectiveness during the collaborative sessions with the elementary students. Some suggested that this collaboration not only helped to improve their computer skills but also allowed them to observe their classmates' teaching styles and strategies. Overall, collaboration with a fellow preservice teacher contributed positively to their Vision Center experience.

Preservice teachers also felt they gained much from the collaboration with the elementary students. Many of the elementary students entered this project with more technology skills than the preservice teachers. Some of the preservice teachers had never used a Macintosh computer. The preservice teachers reported that the elementary students were very excited about being able to teach a teacher something about computers. Not only did this help the preservice teacher when computer glitches occurred, it bolstered the confidence of the elementary students as well. Although the technology skill level of the elementary students was varied, overall the preservice teachers were surprised and pleased to find so many students quite proficient with the technology. This also reinforced the preservice teachers' desire to learn more about the technology so that they may feel more competent when they interact with their students.

Attitudes towards Technology and Technology Integration

As was expected, this technology-based experience broadened each preservice teachers' technology skills. Each learned how to develop a Web page and to harvest Web sites from the Internet. These tasks required that the students find information on the Web, copy clipart, create multiple pages that are then linked, and create links on their pages to other Web sites. The preservice teachers learned how to download sites from the Internet using WebWhacker so that these sites may be visited in classrooms where an Internet hookup is not available. More importantly, having an opportunity to apply what they learned in a real-world setting greatly enhanced their technology knowledge and skills.

The preservice teachers also expressed that their newly gained knowledge gave them additional ideas about how they might integrate technology and their future teaching. All expressed that integrating technology was the most important aspect of their future teaching. Seeing how technology can be infused in teaching and classroom activities provided them with a model to work from - what to do and what not to do. One preservice teacher stated that previously she had "never thought much about computers in a classroom until this semester" (personal communication).

On the end of the semester survey, all of the preservice teachers who volunteered in the Vision Center were able to list at least three applications of technology in their curriculum/content areas. Several mentioned that Web page development could be taught as a tool for students to do subject specific projects and reports, rather than relying on paper-based reports. Others suggested that they became more aware of how using the Internet can enhance learning and the learning process through exploration and discovery. One preservice teacher said she would like to have a Web site for her class where other schools or classes could see what her class was doing and perhaps exchange ideas. She could post homework and assignments that could be accessed by absent students, and she could list valuable web sites for content areas and even parenting skills. She also suggests that teachers, parents and students could communicate by e-mail. As you can see, this technology-based experience enlightened and inspired these preservice teachers.

Problematic Areas

Technology integration and collaboration does not occur without some pitfalls and obstacles. This became quite evident to our preservice teachers - a good lesson to learn in and of itself. First, a general consensus indicated a need for more organization and coordination between the University preservice teachers and the Altamonte faculty. Unlike previous semesters, the University faculty member was not on site at Altamonte Elementary for many of the collaborative sessions. The preservice teachers frequently arrived at Altamonte Elementary with a preconceived idea of what was to occur within the session; however, the classroom teachers' perception of the tasks would not be the same. The preservice teachers felt that this was very evident to the elementary students and that it affected their role as an authority figure. Also, they felt much time was spent getting organized and coordinated rather than on the task to be accomplished. Most expressed that they felt this could be remedied by better organization and communication.

Second, the preservice teachers found it very difficult to work in teams of two with four elementary students at one

computer, especially when they worked in the Vision Center classroom. They observed that the elementary students who were not sitting at the computer often lost interest in the task and were more distracted by the other activities in the classroom, prompting some elementary students to say they felt the session was a waste of time. This was not very reinforcing for the preservice teachers, although they recognized these were circumstances beyond their control. Most suggested that only one preservice teacher work with two elementary students at a time, and that they be allowed to work in the media center away from the classroom activities.

Third, the preservice teachers felt there should be a clear goal for the collaborative project with well planned activities for each session. Although the preservice teachers were successful in teaching the basic skills of Web page development and Web harvesting, they were unable to complete a project that the elementary students could see and show at the end of the term. Thus, the functional tasks had little meaning to the elementary students which the preservice teachers felt contributed to some elementary students' feelings about the usefulness of the project. Some questioned why they were going through the process if they weren't going to do anything with it. One suggestion from the preservice teachers was to create Web pages that were related to a topic the students were currently studying. The elementary students could then search the Internet for related sites to harvest with WebWhacker, and use the Web page as an index to the sites that they found. This would give the elementary students a completed project to strive for and a product that could be used in their classroom activities.

Finally, most of the preservice teachers felt that many problems could be alleviated if more time could be allowed for each collaborative session and if there could be more sessions with each group. (Don't we all wish for such time!) They felt that they could then better overcome the computer glitches and problems with organization, and provide a more coherent project for the elementary students. Many of the preservice teacher teams expressed frustration with computer freezes and problems accessing the Internet. Also, when harvesting sites with WebWhacker, the preservice teachers said that much time was spent waiting for the site to download because of the speed of the connection. This left the team with four idle elementary students, a situation they felt contributed to the elementary students' lack of interest and enthusiasm. Also, the preservice teachers felt additional time would allow for all of the students to have the hands-on experience rather than merely watching the activity, which they viewed as crucial to the projects success.

Summary and Conclusion

It is clear that this collaborative technology-based project brought many rewards for these preservice teachers. Their technology skills were broadened and enhanced, and they gained a new perspective on collaboration with fellow classmates as well as with the elementary students. They all learned much from each other and the collaborative experience. These teachers also learned valuable lessons regarding collaboration and technology integration. Both require considerable planning and clear communication for effective integration to occur. In addition, the value of access to good computer technology became very evident, especially in an elementary school environment. Elementary students' tolerance for idle time is very limited. The preservice teachers found how quickly they could lose their students' attention because of a lack of clear goals and objectives and computer glitches and downtime.

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PRESERVICE TEACHERS' PRECONCEPTIONS ABOUT THE ROLE OF THE COMPUTER IN LEARNING AND TEACHING

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Many educators recognize the potential of computers to change learning and teaching. In so doing, they draw attention to the computer and ignore other factors that would impact the computer's potential in education. The key to influencing the use of the computer is the teacher (Papert, 1993; Byrum & Cashman, 1993); more specifically, the teacher's beliefs (Dupagne & Krendl, 1992; Hannafin & Freeman, 1995; Moar & Taylor, 1995), attitudes toward computers (Byrum & Cashman, 1993; Koohang, 1987), and experiences with computers determine how the computer will be used with students (Byrum & Cashman, 1993; Chiou, 1995; Clement, 1981; Davidson & Ritchie, 1994; Koohang, 1987)

Pedagogical Theories

Computers in education are part of the larger context in which they exist. It is important to consider the instructional theories that dominate because they influence how computers are incorporated into the larger instructional context. Pedagogy refers to the art or science of teaching (Ferguson, 1995). Growing disagreements among learning theorists have centered around which teaching strategies are most effective in the technological classroom. This controversy has inspired the growth of two very different views about teaching and learning (Jonassen & Duffy, 1992). One view, behaviorism, is grounded in systematic, teacher-directed, instruction (Evans & Nation, 1996; Wallace, 1996; Gagne, 1985). The other, constructivism, is based on student-centered knowledge construction (Perkins, 1992; Bransford, Franks, Vye & Sherwood, 1989; Bruner, 1973).

When teaching within a behaviorist framework, instruction is teacher-directed, student objectives are clearly stated and tested, and traditional teaching and assessment methods are emphasized (i.e. lectures, worksheets, tests). Behaviorists believe that students learn through stimulus and response actions. The teacher creates an environment where the students are shown how to complete a task, then students are asked to complete the task using the manner in which they were shown (Burden & Byrd, 1994; Jonassen & Duffy, 1992).

In the constructivist classroom, learning occurs when the student creates his/her own knowledge. The teacher creates an environment in which students develop their own understanding and meaning through experimentation and active engagement. Students are self-motivated and learn through real-life experiences, which help them to construct their own knowledge (Burden & Byrd, 1994; Jonassen & Duffy, 1992). Teachers' use of pedagogical theories are based upon their beliefs and attitudes about knowledge acquisition (Dupagne & Krendl, 1992; Pope & Gilbert, 1983; Tobin, 1990).

Teacher Attitudes and Beliefs About Knowledge Acquisition

Teachers' beliefs about knowledge acquisition influence their instructional practices and their conceptions of the role of the computer in learning and teaching (Hannafin and Freeman, 1995). Dupagne and Krendl (1992) noted that many educators tend to teach in a behaviorist manner in which knowledge is acquired as a result of information being given to the learner. Moreover, teachers who believe knowledge is acquired in a behavioristic manner tend to use the computer for reinforcement or reward (Hannafin and Freeman, 1995). Teachers who believe that knowledge is the product of each students' experiences and construction, find that the interactive nature of the computer enables them to design environments which create knowledge. A teacher's tendency to see students as passive beneficiaries (or active builders) of knowledge may undermine (or enable) their willingness to use the computer for anything other than reinforcement or information recall (Hannafin & Freeman, 1995).

Unger, Draper and Pendergrass (1986) investigated students' beliefs about knowledge acquisition from a world view and categorized their results into two positions: students who held beliefs in the social constructionist position (SC) and students who held beliefs in the logical positivist position (LP). Unger et al. (1986) found that many epistemological beliefs are rooted in life experience, and that many students, due to their epistemological beliefs, would not enroll in courses that were inconsistent with their

beliefs (Unger, 1989). The results of Unger et al. suggest that, an adherence to one epistemological belief over another may effect a preservice teachers' preconceptions about and cognitive development in the area of computer use for learning and teaching.

Computer Use In The Classroom

The early focus of the educational computing community on the features of software applications caused Thomas and Boysen (1984) to theorize about a classification system in which they contended that the categorization of software was insufficient. Thomas and Boysen (1984) argued that "since student learning is the ultimate purpose in utilizing computers for instruction, a taxonomy should focus on the needs of the learner. It should provide guidance for the development of lessons and their instructional use" (1984, p. 15). Thomas and Boysen proposed a taxonomy for computer use in the classroom where the classifying variable was the state of the student with respect to the knowledge being acquired. That is, the role of the computer in instruction was contingent on the students' level of knowledge of the topic being taught. The Thomas and Boysen Taxonomy consisted of five categories: experiencing, informing, reinforcing, integrating and utilizing.

When a new topic is introduced, the student generally has little knowledge of the concepts. The role of the computer at this level is experiencing. The computer helps set the stage for the concepts to be taught and serves as a catalyst for future learning. When using the computer in an informing manner, the student is prepared to receive formal instruction about the topic of study. As such,the computer helps to supplement or replace the textbook and support the initial introduction to a topic. The computer also can be used by the learner to acquire information. When using the computer for reinforcing,the computer helps the learner to strengthen knowledge that has already been acquired. This level is similar to Taylor's (1980) tutor example in that, the student works with the computer to practice and build on concepts that have already been taught to the student by the instructor. At the integrating level, the learner is linking previously unrelated ideas to form new knowledge. In so doing, the computer is used to help make the connections. Also, at the integrating level, students may connect classroom knowledge with real world situations to solve problems. For example the student can work with a program in which the user is asked to sell pizza. Through the use of this program, the student needs to consider sale prices (i.e. percentages) and slices or portions of pizza (i.e., fractions). At the utilizing level the computer functionsas a tool to build, organize, and make students' previously learned knowledge concrete. That is, tool software such as databases and word processors can be used to eliminate menial tasks and allow the student to concentrate on the context and the quality of the finished product (e.g., the arguments presented in the term paper), not the process in which they arrived there (e.g., spelling, punctuation, etc.) (Thomas & Boysen, 1984).

In the Thomas and Boysen Taxonomy, a single computer program can be used at many levels and in many different ways contingent upon the state of the student. If a program is used prior to formal instruction (experiencing), the student is introduced to the topic of study in preparation for formal instruction. If the same program is used after formal instruction, the student will reinforce concepts learned during formal instruction. It is important to recognize that informing and reinforcing programs are based on behavioristic theories, whereas, experiencing, integrating and utilizing programs are constructivist-based. It is these student-directed uses of the computer that force the student to hypothesize about the nature of the content being studied. It is through learner-directed computer use that the highest levels of learning are achieved (Thomas & Boysen, 1984).

The existence of instructional models for computer use will not cause teachers to use computers. There are many factors effecting teachers' use of computers. The instructor's epistemological beliefs effect pedagogical beliefs, which determine how teachers teach.

Inservice and Preservice Teachers' Beliefs and Attitudes Toward Computers in the Classroom

Although many teachers advocate the use of computers in education, this endorsement is given only after they have had experience with computers (Dupagne & Krendl, 1992). Computer experience often fosters positive attitudes toward computers. Lack of training accounts for teachers' low confidence level when they initiate computer activities (Dupagne & Krendl, 1992; Koohang, 1987). This lack of training often results in high anxiety about computer use in the classroom. High levels of anxiety can lead to negative attitudes about computers, and, eventually, negatively influence the use of computers in the learning process (Koohang, 1987).

Dupagne and Krendl (1992) reported that many teachers were skeptical about the value of computers in education. This skepticism related to hostility, fear and uncertainty about how to use computers (Chin & Horton, 1995). Davidson and Ritchie (1994) found that teachers were concerned about the impact computers would have on their role in the classroom. Many teachers feared they might have to compete with computers in the classroom. In addition, Davidson and Ritchie (1994) reported that educators believed teaching with computers would be more complex.

While some teachers viewed the computer as a valuable tool for enhancing student learning, Bosch (1993) found that others saw the computer as a subject to be taught in a separate class. If the computer was taught in a computer class, many teachers believed it did not need to be used in

their class. In addition, teachers thought that there was not enough time for students to carry out computer activities in the content classrooms (Bosch, 1993; Dupagne & Krendl, 1992). Kerr (1991) stated that educators tend to see themselves as teachers first, and as users of technology second. Many teachers stated they had to learn how to use the computer before they could try to integrate it (Kerr, 1991).

Statement of the Problem

Interest in educational computing centers around why some teachers do and others do not use computers (Hannafin & Freeman, 1995). It is important to understand preservice teachers' preconceptions about how computer technologies impact student learning (Darling-Hammond, 1996). Understanding preservice teachers' preconceptions about the role of the computer in the classroom may enable teacher educators to design and implement instruction that will assist in the development of more complete and comprehensive conceptions about computers.

Limitations of the Study

The subjects for this study were undergraduate students at a midwestern university, where the majority of students are midwestern natives. Undergraduate students' experience and knowledge of educational disciplines and the field of education may be a limitation.

The Thomas and Boysen Taxonomy contains five categories. The items in the data collection instrument were configured around these categories, thus limiting the range of responses from which the subjects had to choose. The Thomas and Boysen Taxonomy implies two general levels of computer use in the classroom: simplistic and advanced. Reinforcing and informing are simplistic levels and experiencing, integrating, and utilizing as advanced levels of computer use in the classroom.

Research Procedure

During the first week of the 1997 fall semester, 289 preservice teachers enrolled in an introductory technology course were asked to participate in the study. Students enrolled in the course were informed verbally and in writing that participation in the study was voluntary and that their participation would not affect their final grade.

During the first week, each student was given the Preservice Teacher Perceptions of the Impact of Computer Use on Learning Scale (PTPICL) and asked to complete it. During the second week, students completed the Attitudes About Reality survey (AAR) and the Beliefs About Effective Computer use for Learning assignment (BACL) in their laboratory section.

The instruments contained items believed to effect teacher use of the computer. Two hundred and seventy nine (279) of the two hundred and eighty nine (289) surveys distributed were completed. The final survey response rate was 96.5%. The instruments had a Cronbach alpha reliability coefficient of $r = .8252$ for the PTPICL and $r = .6372$ for the AAR scale.

Research Question Results

The purpose of the study was to investigate preservice teachers' preconceptions about the role of the computer in learning and teaching, and to identify and examine factors that effect preservice teachers' preconceptions about computer use. Below are the results of the four research questions created for use in this study.

Research Question 1

What category of the Thomas and Boysen Taxonomy is most representative of the preservice teacher population?

The data generated by the Impact of Computer Use on Learning (ICL) section of the PTPICL were used to address this research question. This section of the survey consisted of five items for each level of the Thomas and Boysen Taxonomy for a total of twenty five items. Subjects' responses to each item were weighted on a contingency scale using the following system: strongly disagree=1, moderately disagree=3, slightly disagree=5, slightly agree=7, moderately agree=9, strongly agree=11. A mean score for each Thomas and Boysen category was generated for each participant and the sample as a whole. The data revealed that the categories with the highest means were integrating (8.6) and reinforcing (8.5).

A paired t-test was computed to determine if there was a significant difference between the two category means. Results of the paired t-test showed no significance ($p=.066$) between the reinforcing and integrating categories

Research Question 2

Will preservice teachers with high computer proficiency scores conceptualize more advanced ways of using the computer in the classroom?

The subjects were asked to rate their proficiency with computers in four categories: computer based instruction, software, telecommunications, and other. Subjects rated their proficiency using the following five point Likert scale: unfamiliar (0), no proficiency (1), low proficiency (2), medium proficiency(3), high proficiency (4). Overall, the subjects rated themselves moderately proficient with computers (1.930). Specifically, they were moderately with: computer based instructional applications (2.053), telecommunication software (2.050), and tool software (2.120). The respondents had low proficiency in the area of other computer-related technologies (1.459). The subjects were most proficient with word processing (3.344) and email (3.208) applications. The respondents were least proficient in using Hyper Text Mark-up Language (HTML) (.928) and File Transfer Protocol (FTP) (.888) application.

To compare subjects with high computer proficiency and subjects with low proficiency the following scale was

used: 0-2 = low computer proficiency (n = 123), 2-4 high computer proficiency (n = 140). Because the respondents as a whole, rated their proficiency with other computer-related technologies low, this section was not included in the subsequent analysis. The proficiency scores were computed based on the items in the computer based instruction, tools and telecommunication sections. The mean for this section was 2.068. T-tests were computed to determine if there was any difference in ability to conceptualize advanced ways of using the computer between subjects with high computer proficiency and those with low computer proficiency. Results showed that subjects with higher computer proficiency scores conceptualized more advanced ways of using the computer than those who had low computer proficiency scores. Specifically, those with high computer proficiency, conceptualized using the computer in a utilizing manner (p=.003) and in an experiencing manner (p=.050).

Research Question 3

Will preservice teachers with high epistemology scores (social constructionist or constructivist perspectives) conceptualize more advanced ways of using the computer in the classroom?

Data from the 40 item Attitudes About Reality (AAR) scale were examined. This instrument was based on a seven point Likert scale ranging from strongly disagree (1) to strongly agree (7). A mean AAR score was calculated for each subject. The respondents scores ranged from 2.78 to 5.00 with a mean score of 3.88 (four (4) was the mid-point on the AAR scale). Because the majority of the scores fell in the middle of the scale (i.e., eclectic), for comparison purposes, the sample was separated into three epistemological groups: eclectic behaviorist, eclectic, and eclectic constructivist (Hannafin & Freeman, 1995). The eclectic behaviorist group consisted of subjects whose scores ranged from 2.78 to 3.5 (n = 33); the eclectic group consisted of subjects whose scores ranging from 3.53 to 4.00 (n = 130), and the eclectic constructivist group consisted of subject whose scores ranging from 4.03 to 5.00 (n = 59).

An analysis of variance (ANOVA) test was computed to determine if there were significant differences between the three groups on the five categories of the Thomas and Boysen Taxonomy. The data indicated that significant differences existed between eclectic constructivist individuals and both eclectic behaviorist and eclectic individuals for conceptualizing the use of the computer in a utilizing manner. The data indicated that significant differences existed between eclectic constructivist individuals and eclectic behaviorist individuals on the experiencing level.

Research Question 4

Will subjects with low computer attitude scores be able to conceptualize more advanced ways of using the computer in the classroom?

The attitudes towards computers were used to collect data about the respondents' attitudes. Responses in these sections were based on a five point Likert scale ranging from I don't know (0) to strongly agree (4). Overall, the participants held moderately negative attitudes toward computers in general with a mean score of 2.2 and computers in education with a mean score of 1.9.

To determine if subscales existed within the attitudes about computers in general, a rotated varimax factor analysis was computed n the fourteen items from the section. The factor analysis of the attitudes about computers in general resulted in two factors reflecting subjects attitudes towards computers: comfortable with computers and confused by computers. The comfortable with computers factor resulted in a mean score of 2.93 and consisted of four items. The confused by computers factor resulted in a mean score of 1.97 and consisted of six items.

The frequency distribution on the confused about computers factor indicated that 117 respondents were not confused about computers and 161 were confused about computers. The frequency distribution on the comfortable with computers factor indicated that 243 respondents were comfortable with computers and 33 respondents were not. These data suggest that many of the respondents were confused by computers and were comfortable with them.

To determine if there were significant differences between subjects who were and were not confused with computers, a t-test was computed. The t-test showed that subjects who were confused about computers had significant differences in their beliefs about how the computer should be used in the classroom for the informing, reinforcing and utilizing categories of the Thomas and Boysen Taxonomy. To determine if there were significant differences between subjects who were comfortable with computers and subjects who were not, a t-test was computed. The results of the t-test showed that there was no significance between students who were comfortable with computers and subjects who were not.

To determine if subscales existed within the attitudes about computers in education section, a rotated varimax factor analysis was computed on the twenty one items from the section. The factor analysis resulted in four factor reflecting subjects' attitudes about computers in education: computers should be used in the classroom, computers are an unnecessary luxury in the classroom, computers are better than teachers, and computers should be used for rewards.

The computers should be used factor consisted of four items and resulted in a mean score of 3.12. The computers are an unnecessary luxury in the classroom factor consisted

of three items and resulted in a mean score of 1.50. The computers are better than teachers factor consisted of four items and resulted in a mean score of 1.43. The computers should be used for rewards factor consisted of two items and resulted in a mean score of 1.53. Because the latter two factors (computers are better than the teacher and computers should be used for rewards) did not clearly denote positive or negative attitudes about computer use in education, they were not used to address the research question.

To determine if there were significant differences between subjects who thought computers should be used in the classroom and those who did not, the mean scores computed for each subject on the computers should be used in the classroom factor were used. Respondents with a mean 0-2 comprised those who did not think computers should be used in education (n = 14). Respondents with means of 2.1-4 comprised those who thought computers should be used in the classroom (n = 263). A t-test was then computed to compare these groups on each level of the Thomas and Boysen Taxonomy. Subjects who reported that computers should be used in the classroom significantly conceptualized the use of the computer in an informing (p=.001), an integrating (p=.002), and in a reinforcing manner (p=.026) higher than subjects who thought computers should not be used in the classroom.

To determine if there were significant differences between subjects who thought computers were an unnecessary luxury in the classroom and those who did not, the mean scores computed for each subject on this factor were used. Respondents with a mean score of 0-2 comprised those who thought computers were not an unnecessary luxury in the classroom (n = 264). Respondents with mean scores of 2.1-4 comprised those who thought computers were an unnecessary luxury in the classroom (n=13). A t-test was computes to compare these groups on each level of the Thomas and Boysen Taxonomy. The results of the t-test showed that subjects who did not consider a computer to be an unnecessary luxury in the classroom were able to conceptualize the use of the computer in an integrating manner (p=.020) more significantly than students who thought the computer was an unnecessary luxury in the classroom.

Discussion of the Results

Hewson and Hewson (1984) suggest that students develop their ideas through observations and experiences. Those activities designed to strengthen students' understanding of concepts taught in formal instruction are not new to education (Becker, 1991). The results of this study support the conclusion that preservice teachers', prior to formal instruction, conceptualize the use of the computer as a reinforcement. It is interesting to note that the students also conceptualized integrating as an appropriate use of the computer. However, there was no significant difference in their rating of reinforcing and integrating activities (p = .066). Thus, they may not have distinguished any difference between the reinforcing and integrating categories of the Thomas and Boysen taxonomy. The clarity of these categories may have been a limitation of the study.

Although examined as independent constructs, many suggest that attitudes toward computers and computer proficiency are related. Overall, the subjects' attitudes towards computer use in the classroom were moderately negative. Previous research studies have found that preservice teachers and inservice teachers expressed attitudes towards computer use in the classroom such as: high anxiety (Koohang, 1987), low confidence (Dupagne & Krendl, 1992; Koohang, 1987), uncertainty, fear and hostility (Chin and Horton, 1993). Subjects in this study trusted computers, did not feel nervous, were not threatened, and did not lack confidence with computers. Overall, they felt comfortable with using computers. Although the subjects did not feel uncomfortable working with computers, they held poor attitudes toward computers. Only one third (35%) of the subjects felt lost, confused and frustrated when using the computer.

Attitudes towards computers change after receiving formal instruction and after having had experience with computers (Dupagne & Krendl, 1992; Koohang, 1987; Byrum and Cashman, 1993). Results of this study showed that sixty four percent (64%) of the subjects had received formal computer instruction, primarily in high school (75.3%). In contrast to Koohang and others, results of a t-test comparing subjects with formal instruction and subjects without formal instruction showed no significant difference in computer attitudes at the .05 level.

Stevens (1980) attributed poor attitudes towards computer use in the classroom to low computer proficiency. Participants in this study were asked to rate their computer proficiency using a five point Likert scale ranging from unfamiliar (0) to high proficiency (4). Overall the subjects rated themselves with medium proficiency (1.930). Similar to Stevens (1980), results of a t-test comparing subjects who were comfortable with computers and subjects who were uncomfortable with using computers showed significant differences

(p = .000). Subjects who were confused about using computers had significantly lower computer proficiency than subjects who were not confused when using computers (p = .000). The results of t-tests also showed that subjects with high computer proficiency rated using the computer in an experiencing (p=.05) and utilizing (p=.003) manner significantly higher than subjects with low computer proficiency.

Research has shown that beliefs about knowledge acquisition effect the manner in which teachers teach. Moar and Taylor (1995) reported that most teachers teach in a didactic, behavioristic manner. Hannafin and Freeman (1995) and Moar and Taylor (1995) examined the effects of

epistemological beliefs on teachers' use of computers in the classroom. Moar and Taylor's research showed that epistemological beliefs tend to effect how teachers use computers in the classroom. Since many instructors teach in a behavioristic manner, the computer tends to be used most often for reinforcement activities. This research has found that most preservice teachers have eclectic views toward knowledge acquisition. Moreover, subjects who had more constructivist views toward knowledge acquisition were able to conceptualize more advanced ways of using the computer in the classroom than subjects with behaviorist views toward knowledge acquisition. These results are consistent with other researchers (Dupagne & Krendl, 1992, Moar & Taylor, 1995, Hannafin & Freeman, 1995) who have noted that the computer is well suited for instructors who teach using a constructivist framework.

This assessment of preservice teachers' preconceptions about computer use in this classroom serves as a basis for designing instruction that will help preservice teachers to develop more comprehensive conceptions of the role of the computer in learning and teaching. With a national push to restructure education and increase the use of computer-related technology in the classroom, it is imperative to prepare preservice teachers with the knowledge and skills needed to use computer-related technologies effectively to enhance student learning.

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Are Your Students Like Mine? Pre-service Students' Entering Technology Skills: An Update

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The number of microcomputers in K-12 schools has increased dramatically over the past 10 years. The ratio of students per computer in 1988 was reported to be an average of one computer for every thirty children (OTA, 1988). It was projected that by the spring of 1995 the ratio will have decreased to one computer for every 9 students (OTA, 1995).

With more and more students in K-12 schools having access to computers, it might be expected that high school graduates, particularly those who matriculate at a college or university, have some degree of computer literacy skills. Recent research suggests, however, that most college students have not had much experience with a personal computer prior to entering the university (Sheffield, 1996; Sheffield, 1994; McAulay, 1993; Cardinale, 1992; Beaver, 1990).

This paper presents the results of a study of the computer literacy skills of preservice teachers. A prior study conducted by the researcher (Sheffield, 1994) yielded a description of pre-service students self-reported skills in word processing, spreadsheet and database applications. The intent of this study was to expand the original analysis using additional data and more sophisticated statistical analysis. Specifically, the objectives of the study were to (1.) identify the level of experience of pre-service teachers in word processing, database, and spreadsheet applications, (2.) analyze the change in reported experience over 7 academic years, and (3.) determine the effect that such factors as gender, academic classification, comfort with computers, and access to a PC at home have on pre-service teachers' self-reported experience in word processing, database, and spreadsheet applications.

Data Collection and Analysis

The university where the study was conducted is a small public multipurpose institution serving a regional population. There are approximately 6,000 students enrolled in undergraduate and graduate programs in the fall semester of 1993. The College of Education is the second largest in the university in terms of student enrollment (the largest college is science and technology), with approximately 1,900 students.

The participants in the study were preservice teachers enrolled in an introductory educational computing course. Data for the study were collected over 7 academic years, from 1991-92 through 1997-98. At the beginning of each semester, students were administered a questionnaire requiring them to evaluate themselves, using a Likert-type scale, in word processing, data base, and spreadsheet software. The scale ranged from 1 = no experience, to 3 = basic familiarity, to 5 = expert.

Data from each of the fall semesters (739 respondents) were used as cohort groups to analyze the self-reported level of word processing, database, and spreadsheet experience. One-way analysis of variance (ANOVA) was applied to determine whether or not the differences in the means between the cohort groups were statistically significant and yielded a significant linear trend. After a determination that the means were different, the *post hoc* Scheffe test identified the specific pairs of cohorts between which statistically significant mean differences existed. The .05 level of probability was used as the criterion for statistical significance.

There were 4 other variables for which data were collected. In addition to gender and academic classification (freshman, sophomore, junior, senior, or post-baccalaureate/ graduate), students noted if they were computer-phobic and had access to a computer at home. Using Chi-square statistical tests, this analysis focused on whether or not the self-reported skills in word processing, database, and spreadsheet software varied across these variables.

Results

Responses from a total of 1315 respondents over 7 academic years were included for analysis in this study. The gender composition was 29% male and 71% female. The sample consisted primarily of juniors (41%), followed by sophomores (28%) and seniors (18%). Approximately 5% were freshmen and 3% were post-baccalaureate students. Almost one-third of the students indicated that they were computer-phobic; females were more likely than males to indicate that they were not comfortable with computers (Chi-square value = 11.7, p = .00.) Those students who no

access to a PC at home were more likely to report that they were not comfortable with computers (Chi-square value = 25.5. p = .00).

Table 1 shows the overall mean experience level for each software application, from highest to lowest. As shown, students report more knowledge of word processing than either database or spreadsheet.

Table 1.
Overall Level of Experience

Software Program	Mean	Standard Deviation
Word Processing	2.61	1.10
Database	1.78	.92
Spreadsheet	1.69	.92

Generally speaking, the results of the one-way ANOVA for each of the 3 applications indicate that there is (1) a significant difference among the means of each cohort group, and (2) a significant linear trend component.

Word Processing

Figure 1 presents the level of experience for word processing over 7 survey cohort years. With an overall mean of 2.61, students report less than basic familiarity with word processing; this represents the highest rating of all three productivity programs. The trend for word processing experience shows a significant linear pattern of increasing means over time (F = 42.9, P = .000).

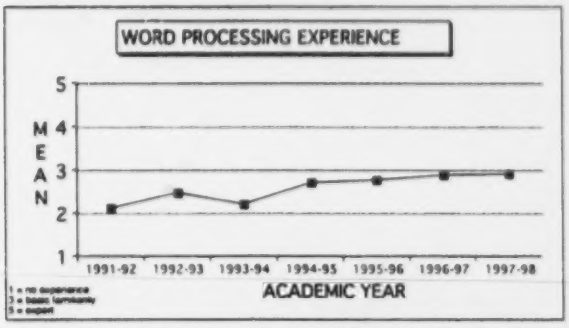

Figure 1. Experience level for Word Processing.

The mean experience level for word processing for 1991-92 (G = 2.13), the first cohort group, is significantly different from the mean experience level for the 1994-95 (G = 2.69), 1995-96 (G = 2.76), 1996-97 (G = 2.89), and 1997-98 (G = 2.90) academic years, the last 4 cohort groups. Similarly, the mean experience level for the 1993-94 (G = 2.21) academic year, the third cohort group, is significantly different from the mean experience level for both the 1995-96 (G = 2.76), 1996-97 (G = 2.89), and 1997-98 (G = 2.90) academic years, the last three cohort groups.

Results of the chi-square analysis of gender, academic classification, comfort with computers, and PC at home are depicted in Table 2. There were no significant differences across gender. However, the results do indicate that there were significant differences across comfort with computers, classification, and PC at home. Students who did not consider themselves computer-phobic rated themselves higher in word processing experience than students who considered themselves computer-phobic. A higher percentage of post baccalaureate/graduate students rated themselves above the basic experience level. Finally, students who reported having access to a PC at home rated themselves higher than students who had no access to a personal computer at home.

Table 2.
Chi Square Values of Specific Factors for Word Processing Experience

Variable	Chi Square Value	Significanc Level
Gender	7.5	.11
Academic classification	32.0	.00
Comfort with computers	97.7	.00
PC at home	85.8	.00

Database

Figure 2 presents the level of experience for database over 7 survey cohort years. Students report even less experience with data base software than word processing; the overall mean is 1.78. The trend for database experience shows a significant linear pattern of increasing means (F=13.3, P=.00).

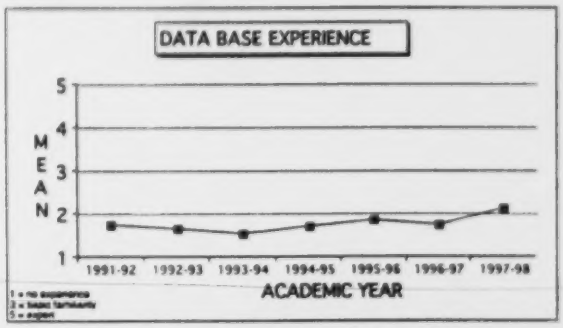

Figure 2. Experience Level for Database.

The mean experience level for database for both the second and third cohort groups, 1992-93 (G = 1.66) and 1993-94 (G = 1.52), were significantly different from the mean experience level for only the 1997-98 (G = 2.11) academic year, the last cohort group. These differences reflect the most recent year of the study.

Results of the chi-square analysis of gender, academic classification, comfort with computers, and PC at home are depicted in Table 3. There were significant differences in experience with database software across all of the variables tested. Males rated themselves higher in database skill than females. A higher percentage of post-baccalaureate students rated themselves at the level of basic familiarity and above.

Students who considered themselves to be computer phobic report less experience with data base software than students who are comfortable with computers. Lastly, students with access to a PC at home rated themselves higher than students without a PC at home.

Table 3.
Chi Square Values of Specific Factors for Database Experience.

Variable	Chi Square Value	Significance Level
Gender	10.0	.04
Academic classification	34.2*	.00
Comfort with computers	90.3	.00
PC at home	65.9	.00

** more than 20% of the cells had an expected frequency of less than 5*

Spreadsheet

Figure 3 presents the level of experience for spreadsheet. This productivity program showed the lowest overall mean experience level of 1.69, indicating that students have even less experience with spreadsheets than word processing and database. The trend for self-reported spreadsheet experience shows a significant linear pattern of increasing means ($F = 21.9$, $P = .00$).

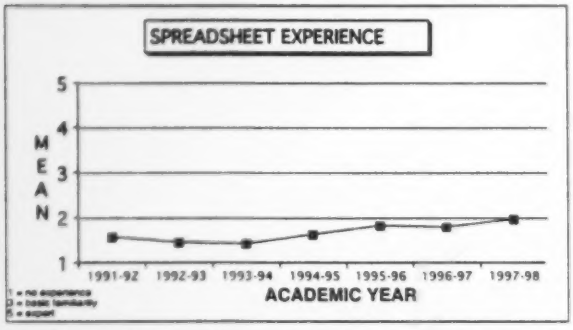

Figure 3. Experience level for Spreadsheet.

Similar to the results for database, the mean experience level for spreadsheet for both the second and third cohort groups, 1992-93 ($G = 1.47$) and 1993-94 ($G = 1.44$), were significantly different from the mean experience level for only the 1997-98 ($G = 1.96$) academic year, the last cohort group. Again, as with database, these differences reflect the most recent year of the study.

Results of the Chi Square analysis of gender, academic classification, comfort with computers, and PC at home are depicted in Table 4. As was the case with database software, there were significant differences across all of the variables tested. Males rated themselves higher in spreadsheet skill than females. A higher percentage of post-baccalaureate students rated themselves at the level of basic familiarity and above. Students who considered themselves to be computer phobic report less experience with spreadsheet software than students who are comfortable with computers. Students with access to a PC at home rated themselves higher than students without such access.

Table 4.
Chi Square Values of Specific Factors for Spreadsheet Experience.

Variable	Chi Square Value	Significance Level
Gender	10.6	.03
Academic classification	26.6*	.04
Comfort with computers	70.0	.00
PC at home	60.3	.00

** more than 20% of the cells had an expected frequency of less than 5*

Discussion Related to Teacher Education

In general, the results of this study indicate that preservice teachers, upon enrollment in their first educational computing course, have little experience with the three most commonly used productivity programs. This may be surprising to those who believe that the increasing presence of computer technology in K-12 schools means that students are entering the university computer literate.

It is clear, however, that over the 7 year period from 1991-92 through 1997-98, students' self-reported experience increased in word processing, database, and spreadsheet software. In all 3 of these categories, there was a significant linear pattern of increasing means, indicating that the level of self-reported experience has increased over the years. The pattern was especially profound with respect to word processing. This suggests that students may have some opportunity to use a word processor, perhaps as they fulfill writing assignments in other university courses. This finding may also be the result of increasing access to computers in high school.

The potential impact on teacher education programs is that in the near future, word processing may be able to be eliminated as a topic in the educational computing course in exchange for other advanced instructional technology issues, such as multimedia, presentation programs, desktop publishing, and curriculum integration of technology. The results of this research can help inform such curricular decisions.

While neither male nor female students appear to have much experience with application software in general, some gender differences have emerged from the study. Males and females report similar levels of experience in word processing, but males rate themselves higher in both database and spreadsheet applications. Males seem to be more comfortable with quantitatively-oriented applications than females. Given this gender variance, professors of introductory educational computing courses may need to consider

specific instructional strategies, e.g. demonstration, practical examples, and problem-solving, that appeal to females and males alike.

Given the distribution of upperclassmen in the sample, a stronger connection between academic classification and computer literacy might have been anticipated. By the time preservice teachers reached their junior year, one would expect that have had some exposure to computer technology. It does appear that post baccalaureate/graduate students report a higher experience level with word processing than any of the other academic classifications. However, limits in the data precluded a conclusive assessment of the relationship of academic classification to word processing, database, and spreadsheet experience.

The preservice teachers in this study who were computer-phobic or who had no access to a PC at home tended to report low levels of experience in all three applications. Opportunities for early experiences with technology through other courses in the teacher education program may alleviate student's concerns with discomfort with computers. For example, faculty could require students to use a word processor for projects, or provide hands-on learning activities that integrate the use of technology into the course requirements.

Future Research

Future research that explores computer literacy in both high school and university students would be informative. By examining student access to and use of technology in high schools, a clearer picture of the development of computer literacy in high school students will emerge. In addition, university students could be studied at the completion of the first educational computing course to measure the acquisition of specific computer literacy skills.

If the role of teacher education programs is to produce teachers who are able to use the new computer technologies, we must take our preservice students from where they are when we get them and advance them to where the technological society needs them to be.

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IMPLICATIONS OF DIFFERENCES IN PERCEPTIONS OF COMPUTERS FOR TEACHER EDUCATION

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Many dynamically interacting variables influence the role of computer technology and the effects of computer-supported activities within an educational setting. Researchers have recognized teachers' and students' experiences with and understanding of computer technologies (Collis & Lai, 1996; Pea & Sheingold, 1987) to be among these factors. Teaching builds on the common knowledge shared by teachers and students in the learning environment (Edwards & Mercer, 1987). The experiences and perceptions brought by the teacher and the students to the learning environment are two factors that influence the degree of common knowledge shared by the participants in that environment.

We live in a world of rapid change driven in large part by the evolution of computer technology. The pervasiveness of the computer in society has resulted in a generation whose members have grown up knowing only a world with computer technology and whose responses to technologies differ considerably from those of adults who have experienced more of the history and many of whose formative experiences occurred at a time when technology was less sophisticated. These differences have led to claims that computer technology is responsible for widening the generation gap (Negroponte, 1995; Turkle, 1984, 1995; Wright, 1988). According to Collis and Lai (1996), "There is little doubt that far-reaching changes have occurred throughout the world within our lifetimes that make the society within which children in the 1990s are growing up different from that for which their parents, grandparents, and teachers prepared" (p. 1). Such differences have created new challenges for teachers who must recognize that they and their students do not necessarily share the same perception of a situation (Perret-Clermont, Perret, & Bell, 1991) or the technology involved (Papert, 1996).

In this paper, I will describe questions and issues raised in a study exploring the effects of differences in teachers' and students' perceptions of computers in a fourth grade classroom. Insights gained from that case study will then be examined in a setting involving the technology-related education of pre-service teachers in an attempt to see what lessons learned in the first setting can be applied in the second setting. Specifically, the paper will raise questions and issues related to the use of technology by teacher educators.

Description of a study concerned with perceptions of computers

In a recent study, I explored the question of what effects differences among teachers' and students' perceptions of computers have in a computer-supported classroom (Stephen, 1997). The study employed qualitative research techniques for an in-depth study of one class of fourth grade students, the classroom teacher and the computer lab teacher in an urban, technology-rich school. Sources of data included: persistent observation; informal and semi-structured interviews with the two teachers and 25 students; and examination of lesson materials, software and students' computer journals. Data collection and analysis extended over a period of eight months. In this study, perception of computers was defined as a combination of an individual's understanding of what computers are, what computers are used for, and what computers are capable of doing; the personal relevance of computers; personal belief about ability to use computers; and level of personal enjoyment using computers. The theoretical foundation for the study was influenced by the belief that social and cultural factors play important roles in learning, and that learning is an active process that involves social interaction, communication and negotiation or sharing of meaning within a cultural setting.

While the teachers in this study had very different experiences with and perceptions of computers than their students, the teachers' experiences and perceptions of computers were surprisingly similar. Both teachers were confident, competent, long-time users of technology who perceived the computer as a tool. This perception of computers influenced the intended use of computers in the activities the teachers designed. Analysis of data revealed

that while the teachers' perception of computers influenced their design of computer-supported activities, other factors, such as teaching style and view of students' competence with computers also played roles in their design of such activities.

Students in this study did not share their teachers' perception of the computer as a tool except in terms of helping them learn to type. Each of the 25 students in the classroom described a computer as either a machine that played games or a machine used to learn or type. While students reported diverse experiences with computers, the descriptions of what they used computers to do did not vary. All students mentioned playing educational games and typing. A survey conducted as part of this study showed the high value students of both genders placed on knowing how to use computers, their perceived ease of using computers, and their universal enjoyment of computer games. Unlike their teachers who had experienced rapid changes in computer technology and predicted significant future changes, students were unaware of changes in technology and described future changes in computer technology in terms of the technology with which they were currently familiar.

In the setting for this study, students' perceptions of computers influenced both their confidence using computers and their understanding of computer-related activities. Students defined expertise with computers as being able to play games and type. When asked how well they could use computers, students interpreted the question in terms of their perception of computers. Smagorinsky (1995) noted that individuals determine how a tool is to be used based on the individual's cultural bias and judge if the tool is successful from that same context. Activities in the computer lab and exploration of software in the classroom reinforced the majority's perceptions of computers, and this in turn, contributed to the students' confidence with computers.

Students' perceptions of computers also influenced their understanding of computer-supported classroom activities. When students were left on their own with computer-supported activities their understanding of the activity and what they actually accomplished in the activity did not necessarily match the teacher's understanding and intended outcome of the activity. The teachers in this study viewed the computer as a tool. They believed it was important for the children to use the computer as a tool, and they designed classroom activities which they believed emphasized the use of the computer as a tool. However, without mediation from the teacher, the way the students approached and understood these activities reflected the children's perceptions of computers, as machines to play games. Guidance provided by the teacher during an activity is a critical element in determining how closely the teacher's and students' understanding of an activity agree. Previous studies support this finding (Collis, Knezek, et al., 1996; Downes & Reddacliff, 1997; Edwards & Mercer, 1987; Salomon, Globerson, & Guterman, 1989).

The study just described points to the importance of recognizing the effects that teachers' and students' experiences and perceptions of computers can have on computer-supported classroom activities. The findings of this study reflect my understanding and interpretation of this one site. Ely (1992) has noted that the importance of results emerging from a single case study lies in the possibility that analysis of the findings might lead to general principles that others in similar situations could follow. Such a study also serves the purpose of raising questions and issues to encourage exploration of these questions and issues in other settings. The questions and issues raised in the study of the fourth grade classroom should also be of interest to teacher educators.

Implications for teacher educators

The fourth grade students in the previous study had remarkably similar perceptions of computers. The students that teacher educators encounter in education classes have experienced more of the changes in computer technology than the fourth grade students have experienced. The pre-service teachers come to our courses with a wide range of perceptions of computers. At the first class meeting of the semester, I ask the pre-service teachers in my instructional technology classes to respond in writing to several questions designed to give me some insights into their experiences with and perceptions of computers. The majority of my students at the small, urban, state college where I teach are non-traditional, first generation college students who have had minimal, if any, exposure to computers in their own K-12 schooling. Many of the students who report prior experience with computers indicate the exposure came through a word-processing class in high school. In one of the questions on my questionnaire, the students are asked to describe what a computer is. There is usually a wide range of responses. The following list illustrates some typical responses and some of the more extreme responses.

- A computer is a man made machine that requires the user to input data in order for it to work. A computer gives output and is a device that is very useful to Man.
- A computer is a tool or instrument used to do different types of programs. Almost like a typewriter but processes information at a greater speed. Takes away people's jobs.
- A computer is a form of expanding new heights to education.
- A computer is a machine to entertain, facilitate learning, and communicate with people globally.
- A computer is something a person under 30 knows about.
- A computer is a tool to gain and express knowledge.

- A computer is something that needs to be upgraded. I believe a computer is a tool that can be used for almost any work that needs to be done. The computer can store, manipulate, and organize information for the user when used properly and with the appropriate programs. Those who learn to use this tool properly will be better off in the future than those who do not.
- A computer is an advanced system that we now use in our daily life which helps us to do a lot of things that we could not have done in the past.
- A computer is the DEVIL INCARNATE!

Once I have obtained the students' responses, I mix an anonymous sampling of their responses with responses to the same question obtained from elementary and middle school children. We then discuss what information we might learn about each individual's perception of computers from these definitions. This exercise is designed to increase their awareness that individuals they will work with, both in this class, and when they are teachers, will not necessarily hold the same view of computers as they do. The exercise includes discussion on what those differences mean in terms of working in cooperative groups on course projects and on their role as a teacher designing and implementing computer-based learning activities.

The way teachers view computers can have an effect on the way their students view computers. Studies with children have established the importance of the teacher's role in modeling the use of technology for students (King, 1994/95, Moore, 1986; Reinem & Plomp, 1996) and as a crucial factor affecting students' attitudes towards computers (Todman & Dick, 1993). In the study of the fourth grade students, the classroom teacher and the computer lab teacher both created computer-related activities that increased the students' confidence in their ability to use computers. A teacher educator also has a responsibility to model the use of technology for pre-service teachers. Decisions the teacher educator makes about how to do that can affect their students' attitudes towards computer technology and the students' confidence in using such technology. But, not all teacher educators view computer technology favorably or approach computer technology with comfort. Solomon (1986) stressed the need for teacher educators to feel comfortable with a computer before they can begin to approach the computer "critically and creatively" (p. 149). The role of technology-using educators as models for future teachers cannot be minimized. This role creates challenges for teacher educators working with pre-service teachers holding negative perceptions of computers. Consider the pre-service teacher who wrote, " A computer is the Devil Incarnate!" or the student, who wrote, "A computer takes away jobs." What kind of activities will they design for their students and how will they model the use of technology? The same question applies to teacher educators who hold negative views of computer technology. The teacher educator needs to provide a variety of experiences designed to increase students' experiences with computers and to expand their understandings of computers and the uses of computers in education.

Decisions made by the teacher on how to integrate the computer into the learning experience can help form the way students view computers, but the students' experiences and perceptions also play a role in how the students' interpret these computer-supported activities (Hawkins, 1987; Newman, Griffin & Cole, 1989; Winograd & Flores, 1986). In the study of the fourth grade students, I found that the students' understanding of the computer as a machine to play games often played a dominant role in how they approached and understood computer-supported activities in the classroom, particularly in situations where there was minimal mediation by the teacher. Teacher educators need to recognize that this same phenomenon can occur in their classes too. A student's view of computers can influence that student's understanding of computer-related activities in the class particularly if there is little or no mediation by the teacher while the student works on such activities. I regularly have my students work on computer-related projects in cooperative groups. Interactions between students in a group as they seek to understand and define their project are often influenced by the combination of how the different students understand and view computers. The challenge to us, as teacher educators, is to be aware and help our students become aware that not everyone has the same view of computers and that this has implications not only for the type of computer-supported activities they design, but also for how the students will understand the activities. Teacher educators face the challenge of designing computer-related experiences that help pre-service teachers question the perceptions of computers they hold when they come into our classes. Our students will face the same challenge when they enter the classroom.

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Cooperating Teachers' Technology Use: Expectations of Student Teachers' Technology Knowledge

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In the fall of 1997, 102 Tucson, Arizona, teachers who serve as cooperating teachers for the College of Education at the University of Arizona were given a survey designed to determine their familiarity with and use of various technologies. They were also asked to respond to questions about how extensively they are supported by their schools in their use of technology. In addition, they were asked to comment about their student teachers' knowledge of technology and what they would like future student teachers to know before starting their student teaching. This article reports the data obtained from 51 cooperating teachers (50% return). Implications drawn from the data will be offered, and suggestions for those who are engaged in the preparation and placement of student teachers in schools will be made.

General Findings

Cooperating teachers (N=51) from twenty-nine schools located in six school districts in the Tucson, Arizona, area are represented.

Table 1 reveals the number of years they have taught.

Table 1.
Number of Years Taught

Years Taught	Frequency	Percent
15+	29	57
11-15	7	14
6-10	13	26
1-5	2	3

Few of the "newest" teachers are cooperating teachers, and over half of the cooperating teachers have taught 15 or more years.

Table 2 reveals the gender of the cooperating teachers.

Table 2.
Gender

Gender	Frequency	Percent
Female	36	71
Male	15	29

More than two-thirds of the responding cooperating teachers are women.

Table 3 reveals the grade levels at which the cooperating teachers are presently teaching.

Table 3.
Teaching Grade Level

Grade Level	Frequency	Percent
9-12	20	39
7-8	5	1
4-6	11	22
K-3	15	29

Respondents were almost evenly divided between elementary and secondary school teachers. A variety of content areas were reported by secondary school teachers.

Table 4 indicates the number of student teachers that the cooperating teachers had worked with in previous semesters/years.

Table 4.

Previous Student Teachers	Frequency	Percent
1-5	31	61
6-10	11	22
11-15	2	4
No response	6	14

Most of the cooperating teachers have a track record of working with previous student teachers. It is likely that the "no response" group is working with their first student teachers.

Table 5 reveals the cooperating teachers' ownership of personal computers.

Table 5.

Ownership	Frequency	Percent
Yes	43	84
No	8	16

By far, the cooperating teachers surveyed own their own computers.

Table 6 shows the number of computers these teachers have in their own classrooms.

Table 6.

Classroom Computers	Frequency	Percent
1	22	43
2-10	24	47
11-20	1	2
No response	4	8

A little over 40% of the cooperating teachers have just one computer in their classroom. Most of the others have between two and ten computers for classroom use. Perhaps, eight percent have no computers in their classrooms.

Table 7 reports the number of teachers who take their students to a computer lab.

Table 7.

To Lab	Frequency	Percent
Yes	36	77
No	13	26
No response	2	3

Over two-thirds of the students in these teachers' classrooms visit a computer lab.

Table 8 reveals the number of times each week students visit computer labs.

Table 8.

Number of Times	Frequency	Percent
1	25	49
2	8	16
3	1	2
5	1	2
5+	1	2
No response	15	29

Students in about half of the cooperating teachers classes visit computer labs once a week. Few students visit a computer lab more than twice each week, and approximately 30% do not visit computer labs at all.

Table 9 indicates which computer platforms the teachers had used.

Table 9.

Type of computer	Frequency	Percent
Apple/Mac/PC	31	61
Apple/Mac	18	35
PC	1	2
Unix	1	2

The survey reveals that most cooperating teachers were familiar with both of the major computer platforms. If they knew just one type of computer, it is most likely to be an Apple computer.

Use of Applications

After asking for background information, the survey becomes more specific, asking cooperating teachers about their usage of various types of technology applications. Teachers were asked to rate twenty-four items, most of which are applications for computers. They were asked to indicate whether they used the items *frequently*, used them in a *limited* fashion, or made *no use* of the items. They further indicated whether or not the items *were available* for use in their school. Tables 10-16 report the findings from this portion of the survey.

Table 10 shows, in descending order of frequency of teacher use, those applications that the cooperating teachers say they frequently use.

Table 10.
Applications Used Frequently by Cooperating Teachers

Application	Percent
Word Processing	71
Utility	49
VCR	41
Calculator	29
Teaching Software	27
CD-ROM	20
Graphics	20
Netscape/Navigator	18
Multimedia	16
E-mail	16
Spreadsheet	14
Desktop Publishing	14
Camcorder	14
Database	12
Telecommunications	10
Videodisc	6
Statistical	4
Image Processing	2
Scanner	2
Authoring	2
FTP	0
Probeware	0
Electronic BBs	0

The only computer application that teachers use frequently is word processing. Almost half of the cooperat-

ing teachers use teacher utility programs such as grade books and electronic attendance sheets. VCRs are also used frequently. None of the other applications is used by many of the cooperating teachers.

Table 11 indicates, in descending order of frequency of teacher use, those applications that the cooperating teachers say they use on a limited basis.

Table 11.
Applications Used on a Limited Basis by Cooperating Teachers

Application	Percent
VCR	53
Database	53
Spreadsheet	51
Camcorder	51
Teaching Software	47
Multimedia	47
Desktop Publishing	47
CD-ROM	41
Telecommunications	37
Scanner	35
Graphics	33
Netscape/Navigator	33
Calculator	29
Word Processing	27
E-mail	25
Videodisc	25
Utility	23
Authoring	22
Statistical	16
Video editing	16
Image Processing	16
Probeware	12
Electronic BBs	10
FTP	4

While older technology such as VCRs and camcorders are listed as being used in a limited way, databases and spreadsheets are being used by half or more of the cooperating teacher at least some of the time in their teaching. Nearly half of the teachers also use teaching software, multimedia, and desktop publishing in their work.

Table 12 combines the Frequent Use and Limited Use categories in order to reveal the highest ranking applications that do get used by cooperating teachers.

The use of word processing and VCRs is nearly universal, and about three-quarters of the teachers use teaching software and teacher utility programs. While using them less frequently, two-thirds of the cooperating teachers do make some use of spreadsheets, databases, camcorders, and multimedia.

Table 12.
Applications used Either Frequently or on a Limited Basis by Cooperating Teachers

Application	Percent
Word Processing	98
VCR	94
Teaching Software	74
Utility	72
Spreadsheet	65
Database	65
Camcorder	6
Multimedia	63
CD-ROM	61
Desktop Publishing	61
Calculator	58
Graphics	5
Netscape/Navigator	51
Telecommunications	47
E-mail	41
Scanner	37
Videodisc	31
Authoring	24
Statistical	20
Image Processing	1
Video Editing	18
Probeware	12
Electronic BBs	1
FTP	4

Table 13 reveals the applications that the cooperating teachers say they do not use.

Table 13.
Applications Not Used

Application	Percent
E-mail	35
Electronic BBs	31
Spreadsheet	27
Authoring	2
Statistical	27
Database	24
Video Editing	23
Telecommunications	23
Scanner	22
Calculator	22
Videodisc	20
Desktop Publishing	20
Multimedia	18
Camcorder	18
FTP	16
Graphics	16
CD-ROM	1
Image Processing	1
Utility	12
Netscape/Navigator	12
VCR	6
Teaching Software	
Probeware	4
Word Processing	2

About one-third of the cooperating teachers report that they do not use e-mail and electronic bulletin boards. About one-fourth of the teachers do not use spreadsheets, authoring systems, statistical applications, and databases.

Table 14 indicates those applications that teachers report are not available to them.

Table 14.
Applications Not Available

Application	Percent
Probeware	51
Video Editing	41
FTP	41
Statistical	37
Videodisc	37
Electronic BBs	37
Image Processing	35
Authoring	29
Scanner	23
Netscape/Navigator	21
E-mail	20
Telecommunications	18
Graphics	17
CD-ROM	15
Utility	14
Teaching Software	14
Calculator	14
Multimedia	13
Camcorder	11
Spreadsheet	6
Database	5
Desktop Publishing	5
VCR	0
Word Processing	0

Over half of the teachers indicated that probeware was not available to them. About 40% indicated they had no access to video editing equipment nor a way to FTP files. Image processing as well as electronic bulletin boards, videodiscs, and statistical applications are reported to be unavailable to one-third or more of the cooperating teachers.

Table 15 combines the *Not Use* and *Not Available* responses to give a fuller picture of the applications that teachers either do not or cannot use.

Table 15.
Applications Teachers Do Not Use

Application	Percent
Electronic BBs	68
Video Editing	64
Statistical	64
Videodisc	57
FTP	57
Authoring	56
Probeware	55
E-mail	55
Image Processing	49
Scanner	45
Telecommunications	41
Calculator	36
Netscape/Navigator	33
Graphics	33
Spreadsheet	33
CD-ROM	31
Multimedia	31
Database	2
Camcorder	29
Utility	2
Desktop Publishing	25
Teaching Software	18
VCR	6
Word Processing	2

Over two-thirds of the cooperating teachers do not or cannot work with electronic bulletin boards, video editing, or statistical applications. Half or more do not or cannot deal with e-mail, probeware, authoring applications, file transfer protocols, or videodiscs.

Table 16 reports those items for which no responses were give.

Table 16.
No Response

Application	Percent
FTP	39
Image Processing	33
Probeware	33
Electronic BBs	2
Authoring	22
Video Editing	18
Scanner	18
Netscape/Navigator	16
Statistical	16
Graphics	14
Desktop Publishing	14
Videodisc	12
Telecommunications	12
Teaching Software	
CD-ROM	8
Database	6
Multimedia	6
Camcorder	
Calculator	6
E-mail	4
Utility	2
Spreadsheet	2
Word Processing	0
VCR	0

One-third or more of the cooperating teachers did not check a response to probeware, image processing, or FPT questions. About twenty percent of the teachers did not respond to questions about electronic bulletin boards and authoring software.

Additional Survey Information

The last part of the survey dealt with miscellaneous information about the teachers' use of computer applications, their assessment of technology assistance in their schools, and what they would like their student teachers to know about technology. This section reveals these findings.

Table 17 shows the cooperating teachers' confidence in identifying computer software that is instructionally sound in design and content.

Table 17.
Prepared to Identify Software

Response	Percent
Yes	67
No	33

Two-thirds of the teachers believe they can competently identify sound computer software.

Table 18 identifies the number of software programs the teachers have personally evaluated.

Table 18.
Number of Software Programs Evaluated

Number	Percent
7 or more	31
4-6	20
1-3	28
None	20
No response	1

Table 19 reports the teachers' confidence in integrating computers into students' curriculum.

Table 19.
Ability to Integrate Computers into the Curriculum

Response	Percent
Yes	75
No	22
No response	3

Two-thirds of the teachers are confident that they can integrate computers into the curriculum.

Table 20 requests teachers to indicate their preparedness to purchase computer software.

Table 20.
Preparedness for Purchasing Software

Response	Percent
Yes	61
No	37
No response	2

About two-thirds of the teachers believe they can make intelligent purchases of computer software.

Table 21 requests teachers to indicate their preparedness to purchase computer hardware.

Table 21.
Preparedness for Purchasing Hardware

Response	Percent
Yes	61
No	39

About two-thirds of the teachers believe they can make intelligent purchases of computer hardware.

Table 22 reports the number of teachers who have technical support people available in their schools at all times.

Table 22.
Technical Support Always Available

Response	Percent
Yes	67
No	33

Two-thirds of the teachers have full-time technical support in their schools.

Table 23 reports the adequacy of the technical support the teachers receive.

Table 23.
Adequacy of Technical Support

Rating	Percent
Outstanding	22
Very good	2
Good	29
Poor	12
Very Poor	8
No response	1

Half of the teachers believe their technical support is most satisfactory, while twenty-one percent were dissatisfied with their support.

Table 24 reveals teachers' degree of comfort in being an independent learner of new technology in their fields.

Table 24.
Independent Learner

Rating	Percent
Outstanding	22
Very Good	2
Good	39
Poor	10

Just over half of the teachers believe they are comfortable, independent learners of new technology in their own fields.

Table 25 reports teachers' use of presentation products in teaching.

Table 25.
Use of Presentation Products

Response	Percent
Yes	6
No	88
No response	6

Hardly any teachers use presentation products in their teaching.

Table 26 reveals cooperating teachers' appraisal of their most recent student teacher in the use of technology.

Table 26.
Student Teacher's Preparation in Using Technology

Rating	Percent
Very well	20
Well	28
Somewhat	29
Poor	12
Very poorly	4
No response	7

Less than half of the cooperating teachers believed their student teachers were prepared well or very well to use technology.

Comments by Cooperating Teachers

Comments were made by 37 cooperating teachers in response to a question about the use of technology by them or their school. By far, most of the comments dealt with their inability to access computers because the labs are used extensively. Almost no comments indicated that the teachers used computers for direct instruction with students.

Comments were made about specific technology applications and specific knowledge that the cooperating teachers would like student teachers to know more about. Some items are not applications, but teachers believe they are important for student teachers to know. The specific areas mentioned are:

Word processing (9 people mentioned), basic operations of a computer—Mac and PC (8), spreadsheets (6), Internet (4) gradebooks (3), research skills (on Internet) (3), calculator (2), general computer literacy (2), keyboarding (2), types of software available (2),VCR (2), CD-ROM, desktop publishing, doing lesson plans on a computer, e-mail, experience in a computer lab, laserdiscs, multimedia, music software, probeware, software evaluation, teacher utility programs.

Specific programs mentioned by the teachers were: PrintShop, Finale, Advantage, Pyware, Making the Grade (2), Computer-Based Lab program, ClarisWorks (2), Kid Pix, Writing Center, GroupSystems, Logo, and Word Perfect.

Comments were made about the kinds of technology the cooperating teachers, themselves, want to learn more about. Specific items mentioned were: E-mail (4 people responded), Internet, (3) music technology and software (3), scanner (3), physical education software (2), basic information about computers, calculator-based lab programs, camcorder, databases, Excel, Graphics, GroupSystems, Hypercard, image processing, multimedia, presentation tools, Spanish language software, spreadsheets, telecommunications, and word processing.

Implications and Suggestions

Findings from the survey have implications for teacher preparation institutions as well as for cooperating teachers. The cooperating teachers surveyed have been in the teaching profession for quite some time. This may be a problem, since it ensures that probably none of the cooperating teachers grew up with technology and, if they *are* computer savvy, they had to learn on their own or through district efforts. In sum, teachers in the profession 15 years *may* not be the best people to model technology to beginners. It is encouraging, however, that over 80% of the teachers own their own computers. Unless they are connected to the Internet, however, it is likely that the teachers are using them mainly for word processing.

The number of classrooms with one or more computers reported in this study may not accurately reflect national trends. Although most of the teachers take their students to labs, students have access to computers relatively infrequently, and this may be a barrier to promoting the effective use of technology for either teaching or learning.

Findings indicate that cooperating teachers use technology most for word processing and use mainly those teacher utility programs that help them maintain their classes. Few of the computer technologies that are likely to impact teaching/learning best are used with great frequency, partly because they are not available. Even when some applications were available, many did not use them in instruction possibly because they do not use them for their own teaching or because they don't know how to use the applications for teaching/learning. Some of the applications (FTP, probeware, and electronic bulletin) may not be used because teachers are unclear what they are.

Teachers' belief that they can confidently identify "good" software is questionable, since half never evaluated more than three software programs. It is highly questionable, with such little exposure to evaluation of software and their limited faculty development opportunities, that

teachers can competently integrate computers into a student-centered, constructivist, learning environment. Since only half of the teachers believe they are comfortable being independent learners of technology, it appears critical that faculty development activities be provided.

Teachers surveyed were very happy with their technical support people, and they reported almost full access to them. (Note: one of the districts, because of a successful bond approval, was able implement technology swiftly compared with most.) Schools should look at the technical support issue carefully.

Fewer than half of the teachers were satisfied with their student teachers' preparation in using technology, and they made specific recommendations that should inform teacher preparation programs. They also suggested areas that districts could consider when planning faculty development activities. Finally, almost 90% of the teachers do not use even an easy-to-use presentation product in their teaching. Not only does this fact indicate that the lecture format is probably the main method of teaching, but it also indicates that students in the schools are not in a position to share their on-line or off-line presentations effectively.

PARALLEL FORMS FOR MEASURING TEACHERS' ATTITUDES TOWARD COMPUTERS

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Positive teacher attitudes toward computers are widely recognized as a necessary condition for effective use of information technology in the classroom (Woodrow, 1992). At least fourteen instruments with acceptable measurement properties have been reported in the literature over the past decade (Chu & Spires,1991; D'Souza, 1992; Francis,1993; Gardner et al.,1993; Kay,1993; Knezek & Miyashita 1994; Loyd & Gressard, 1984; Pelgrum, Janssen Reinen & Plomp, 1993; Woodrow, 1991). During 1995-96, a compendium of these instruments for assessing teachers' attitudes toward computers was administered to 621 educators in Texas, Florida, New York, and California. Reliabilities for the resulting Teachers' Attitude Toward Computers Questionnaire (TAC), which contained a total of 284 items falling on 32 Likert subscales, were presented at SITE '97 (Christensen & Knezek, 1997).

Construct Validity

Additional data analysis has been performed on the TAC with the goal of refining it to be a more parsimonious instrument. The primary questions were: (a) Does the instrument really measure 32 separate attributes? and (b) Are 284 items really needed to cover the domain measured by the TAC? A factor analysis of the 284 individual items on the questionnaire, using the 621 responses, indicated that between four and twenty-two different attributes were actually being measured by the items collected from the 32 previously published subscales. Examination of the factor structures for all 4-22 feasible solutions resulted in selections of 7-factor, 10-factor, and 16 factor structures for development into derivations of the TAC. For the seven-factor solution, 135 items were found to be sufficient to cover the entire domain. The names assigned to the factors identified, and the reliability for each measurement index produced by summing the responses to items closely related to each factor, are listed in Table 1.

Table 1.
Seven Factor Structure of TAC

	Alpha	No. variables		
F1(Enthusiasm/Enjoyment)	.97	30		
F2(Anxiety)	.97	30		
F3(Avoidance)	.90	13		
F4(Email for Classroom Learning)			.95	11
F5(Negative Impact on Society)			.85	11
F6(Productivity Improvement)	.96	30		
F7(Semantic Perception of Comp.)			.94	10

Parallel Forms Development

Within the seven factor structure of the TAC we found sufficient numbers of highly loading items to enable the derivation of parallel forms (Form A and Form B) for three subscales. We envisioned that parallel forms might be especially useful for short-term training sessions where it is possible that respondents remember their previous responses to items administered several hours (or days) before the post test, if both versions are identical. Parallel forms would remove one source of pre-post measurement bias (Campbell and Stanley, 1961).

An iterative procedure was carried out to produce equivalent forms for a subscale. First the items for a given subscale were arbitrarily divided into even items (Form A) and odd items (Form B), with the single strongest loading item retained as item 1 and duplicated on both forms of the subscale. Next, remaining items were shuffled from Form A to B and vice-versa, as necessary, so that highly similar items would fall on opposite forms. Finally, the discrimination ability of each shorter form was checked by carrying out an analysis of variance among 1995-96 sites. Stronger items were exchanged with their weaker counterparts on the other subscale, Form A to B or vice versa, until the F-ratios (discrimination ability) of each form was as close to identical as possible.

Discussion

Fifteen item Likert-type questionnaires require very little time for respondents to complete. The availability of parallel forms instrument for the subscales of enthusiasm, anxiety, and productivity improvement makes it practical

for teacher educators to administer one or more of these to their trainees, in a pre-post fashion, even when the sessions are relatively short and time is of the essence. Items for form A and B for each of the three previously mentioned subscales are listed in the Appendix (items for the remaining four subscales are also listed). It is our hope that practitioners will find them useful.

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Appendix
TAC Seven Factor Structure

Factor 1 (Enthusiasm/Enjoyment) Form A

Var no.	Items
186	I think that working with computers would be enjoyable and stimulating.
103	I want to learn a lot about computers.
211	The challenge of learning about computers is exciting.
180	Learning about computers is boring to me.
181	I like learning on a computer.
195	I enjoy learning how computers are used in our daily lives.
249	I would like to learn more about computers.
53	I would like working with computers.
101	A job using computers would be very interesting.
270	I enjoy computer work.
266	I will use a computer as soon as possible.
65	Figuring out computer problems does not appeal to me.
224	If given the opportunity, I would like to learn about and use computers.
191	Computers are not exciting.
102	Computer lessons are a favorite subject for me.

Alpha = .96 (15 Items)

Factor 1 (Enthusiasm/Enjoyment) Form B

Var no.	Items
186	I think that working with computers would be enjoyable and stimulating.
187	Learning about computers is interesting.
193	It is fun to figure out how computers work.
99	Computers can be exciting.
209	I look forward to using a computer on my job.
194	Learning about the different uses of computers is interesting.
185	The challenge of solving problems with computers does not appeal to me.
189	Computers are boring.
267	I will take computer courses.
188	I enjoy using a computer.
246	If I can, I will take subjects that will teach me to use computers.
243	I would like to spend more time using a computer.
100	I like reading about computers.
81	I will do as little work with computers as possible.
98	I like to talk to others about computers.

Alpha = .95 (15 Items)

Factor 2 (Anxiety) Form A

Var no.	Items
263	I get a sinking feeling when I think of trying to use a computer.
230	Working with a computer makes me feel tense and uncomfortable.
182	Working with a computer would make me very nervous.
227	Computers intimidate and threaten me.
264	Computers frustrate me.
88	I have a lot of self confidence with it comes to working with computers.
153	I sometimes get nervous just thinking about computers.
112	A computer test would scare me.
141	I feel apprehensive about using a computer terminal.
231	Computers are difficult to understand.
177	I feel at ease when I am around computers.
157	I sometimes feel intimidated when I have to use a computer.
15	I feel comfortable working with a computer.
20	Computers are difficult to use.
51	Computers do not scare me.

Alpha = .96 (15 Items)

Factor 2 (Anxiety) Form B

Var no.	Items
263	I get a sinking feeling when I think of trying to use a computer.
260	Computers make me feel uncomfortable.
256	Working with a computer makes me feel very nervous.
87	Computers make me feel uneasy and confused.
117	I have a lot of self confidence when it comes to using computers.
145	I hesitate to use a computer for fear of making mistakes I cannot correct.
219	I feel apprehensive about using computers.
259	Computers are confusing.
225	I have avoided computers because they are unfamiliar and somewhat intimidating to me.
233	I feel helpless when asked to perform a new task on the computer.
247	Computers sometimes scare me.
258	I feel threatened when others talk about computers.
13	I think that computers are very easy to use.
244	I do not feel I have control over what I do when I use a computer.
178	I feel comfortable when a conversation turns to computers.

Alpha = .96 (15 Items)
Factor 6 (Productivity Improvement) Form A

Var no.	Items
202	Computers would increase my productivity.
204	Computers would help me learn.
226	I feel computers are necessary tools in both educational and work settings.
175	Computers can be a useful instructional aid in almost all subject areas.
207	Computers improve the overall quality of life.
94	Knowing how to use computers is a worthwhile skill.
149	Having a computer available to me would improve my general satisfaction.
162	Computers will improve education.
163	Someday I will have a computer in my home.
137	I will use a computer in my future occupation.
147	If I had to use a computer for some reason, it would probably save me some time and work.
170	Computers can be used successfully with courses which demand creative activities.
168	Teacher training should include instructional applications of computers.
66	I'll need a firm mastery of computers for my future work.
12	I believe that it is important for me to learn how to use a computer.

Alpha = .93 (15 Items)
Factor 6 (Productivity Improvement) Form B

Var no.	Items
202	Computer would increase my productivity.
93	Knowing how to use computers will help me do well in my career.
203	Computers would save me time.
113	I'll need computers for my future work.
109	Knowing about computers will help me earn a living.
201	Computers would help me organize my work.
78	Knowing how to work with computers will increase my job possibilities.
148	If I used a computer, I could get a better picture of the facts and figures.
151	Computers are probably going to be an important part of my life.
199	Computers would stimulate creativity in students.
97	Having computer skills helps you get better jobs.
91	Computers can help me learn things more easily.
198	Computers would help students improve their writing.
179	Teacher training should include instructional applications of computers.
196	Computers would motivate students.

Alpha = .93 (15 Items)
Factor 3 (Avoidance)

Var no.	Items
150	If I had a computer at my disposal, I would try to get rid of it.
192	Studying about computers is a waste of time.
74	I can't think of any way that I will computers in my career.
154	I will probably never learn to use a computer.
123	I see the computer as something I will rarely use in my daily life as an adult.
262	Not many people can use computers.

214 Learning to operate computers is like learning any new skill - the more you practice, the better you become.
94 Knowing how to use computers is a worthwhile skill.
84 I do not think that I could handle a computer course.
272 I would never take a job where I had to work with computers.
224 If given the opportunity, I would like to learn about and use computers.
261 You have to be a "brain" to work with computers.
164 Someday I will have a computer in my home.

Alpha = .90 (13 Items)
Factor 4 (Email)
Var no. Items

282 The use of E-mail makes the student feel more involved.
284 The use of E-mail helps provide a better learning experience.
281 The use of E-mail makes the course more interesting.
283 The use of E-mail helps the student to learn more.
280 The use of E-mail increases motivation for the course.
276 More courses should use E-mail to disseminate class information and assignments.
278 The use of E-mail creates more interaction between students enrolled in the course.
279 The use of E-mail creates more interaction between student and instructor.
277 E-mail provides better access to the instructor.
274 Electronic mail (E-mail) is an effective means of disseminating class information and assignments.

275 I prefer E-mail to traditional class handouts as an information disseminator.
Alpha = .95 (11 Items)
Factor 5 (Negative Impact on Society)

Var no. Items

142 Computers are changing the world too rapidly.
215 I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills.
138 Computers dehumanize society by treating everyone as a number.
135 Our country relies too much on computers.
144 Computers isolate people by inhibiting normal social interactions among users.
176 Use of computers in education almost always reduces the personal treatment of students.
134 Computers have the potential to control our lives.
241 Working with computers makes me feel isolated from other people.
218 I dislike working with machines that are smarter than I am.
257 Using a computer prevents me from being creative.
251 Working with computers means working on your own, without contact with others.
Alpha = .85 (11 Items)
Factor 7 - Kay's Semantic
Computers are:

44. Unpleasant		Pleasant
50. Suffocating		Fresh
49. Dull		Exciting
41. Unlikable		Likable
46. Uncomfortable		Comfortable
43. Bad		Good
42. Unhappy		Happy
45. Tense		Calm
48. Empty		Full
47. Artificial		Natural

Alpha = .94 (10 Items)

FACTORS INFLUENCING ELEMENTARY TEACHERS' INSTRUCTIONAL COMPUTER USE

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Research suggests that at the elementary level computers are overwhelmingly used for drill and practice or instructional gaming (Evans-Andris, 1995; Office of Technology Assessment (OTA), 1995; Becker, 1994). Research also suggests that current instruction would not be altered if computers were suddenly unavailable for use (Marcinkiewicz, 1994). However, approximately $500 million dollars have been spent on new computers over the last decade. The mismatch between the amount of money spent on computers and the nature of their instructional use suggest that teachers must be better prepared to use computers in instruction.

A large school district in southeastern Virginia commissioned the present study to explore this mismatch. They sought to identify instructional uses of computers by elementary teachers (grades one through five) and factors that may contribute to these uses. The end goal was to develop recommendations for inservice teacher preparation within the district that may result in increased effective instructional computer use. Skill, support and self-efficacy were explored as they related to the instructional computer uses reported by teachers.

Method

The population (N=1298) for the present study was teachers from the 53 elementary schools in the district. Systematic random sampling was used to ensure that all schools were represented in the sample of 300 teachers (Babbie, 1990). The sampling error for the survey was plus or minus ten percent. The sample was well distributed among grade levels with no less than 18% and no more than 23% of the sample being represented by a single grade level.

A pilot study of 23 elementary teachers served as the initial validation for the instrument. The instrument included 98 items and took ten to fifteen minutes to complete.

Stepwise multiple regressions were used to predict *Instructional Computer Use* from *Skill*, *Self-Efficacy*, and *Support*. Variables were entered into the equation if their significance level was less than .05 and removed if their significance level was greater than .05. Ninety-two percent (92%) of the selected teachers returned the survey.

Results Regarding Types of Instructional Computer Use

Teachers reported using computers most frequently for motivating interest in schoolwork, for mastery of language arts/math skills and for remediating deficiencies in some students and least commonly for learning research and study skills and for communicating with others.

A closer examination of how teachers reported using computers in instruction was accomplished using factor analysis (see Table 1). The first factor contained five items reflecting *Traditional Instructional Computer Use* Teachers with high scores on this factor tend to use the computer to motivate faster learners by challenging them with more difficult concepts and skills and to motivate slower learners by reviewing concepts and skills previously covered in class. The second factor contained four items reflecting *Instructional Computer Use via Curricular Integration.* Teachers with high scores on this factor tend to integrate the computer into the curriculum by communicating with others, by integrating writing activities, and by implementing research activities. The third factor contained one item reflecting *Instructional Computer Use as Reward for Completing Work* Teachers with high scores on this factor tend to use the computer as a reward for completing assigned classwork.

Results Relating to Skill

Measurements of *Skill* included use of computers for non-instructional activities and computer training. For the purposes of the present study non-instructional uses were defined as uses that did not directly relate to classroom instruction. Word processing and graphics were reported to be used most frequently for non-instructional activities while databases and spreadsheets were reported to be used the least frequently. These uses were collapsed into a single factor, renamed *Professional Use* (see Table 2). Teachers scoring high on this factor report using all the applications for non-instructional activities.

Table 1.
Factor Analysis for Instructional Use

Instructional Use	Traditional	Curricular	Reward
For mastery of language arts/math skills	.80		
For understanding math & science concepts	.68		
For remediating deficiencies in some students	.68		
For challenging the brightest students	.68		
For motivating interest in schoolwork	.53		
For communicating with others		.70	
For teaching about computer parts		.61	
For improving student writing skills		.50	
For learning research and study skills		.50	
As a reward for completing work			.88

Table 2.
Factor Analysis for Non-Instructional Use

Application	Professional Use
Graphics	.79
Databases	.78
Spreadsheets	.73
Word Processors	.71
Telecommunications	.62
Gradebooks	.49

Teachers reported having the most formal training on word processors and the least formal training on computerized gradebooks. Over half of the teachers reported never learning how to use databases, gradebooks, and spreadsheets while over half of the teachers report learning classroom organizational skills related to technology via personal trial-and-error. A principal component factor analysis yielded three factors relating to computer training (see Table 3). The first factor contained four items reflecting *General Tools Training.* Teachers with high scores on this factor tend to have had training with general tools such as databases, spreadsheets, word processors, and graphics. The second factor contained two items reflecting *Classroom Integration Training.* Teachers with high scores on this factor tend to report that they have had training on how to integrate computers into their curriculum. The third factor contained two items reflecting *Training with Gradebooks and Telecommunications.* Teachers with high scores on this factor tend to have had training with these two applications.

Table 3.
Factor Analysis for Computer Training

Application	Tools	Integration	G & T
Databases	.86		
Spreadsheets	.83		
Graphics	.72		
Word Processing	.62		
Classroom Organization		.87	
Lesson Integration		.85	
Computerized Gradebooks			.80
Telecommunications			.73

Table 4.
Factor Analysis for Support Items

Indicator	Access/ Technical	Curricular	Peer	Time
Computer related technology in my school is generally in adequate working condition	.75			
My administration provides equal access to computers	.74			
If I have a computer problem I can find assistance in my building	.71			
My school has the hardware I need to effectively integrate computers into the curriculum	.66			
I can easily access computers for instructional use in my school	.58			
My school has relevant software that I can use in my instruction	.51			
I am satisfied with the support I receive from my district related to integrating computers in the curriculum		.86		
My district provides computer training that helps me to integrate computers into the curriculum		.83		
I am satisfied with the technical support I receive from my district		.79		
I am provided adequate opportunities to learn to integrate computers in the curriculum during the school year			.54	
I have colleagues that I can collaborate with to plan computer based activities related to the curriculum			.78	
I have colleagues that I can talk to about using computers in instruction			.68	
Many teachers in my school use computers in instruction			.68	
There is adequate time during the day to integrate computers in the curriculum				.82
I have time to plan for computers in my instruction				.73
I have adequate time to learn about the computer resources available to me				.67

Results Regarding Support

Teachers reported being most satisfied with the access and technical support they receive while they report being least satisfied with the time support they receive. A principal component factor analysis yielded four factors related to support (see Table 4). The first factor contained six items reflecting satisfaction with *Access and Technical Support*. The second factor contained four items reflecting *Curricular Support*. The third factor contained three items reflecting *Peer Support*. The fourth factor contained three items reflecting *Time Support*. Teachers with high scores on these factors tend to report satisfaction with the type(s) of support represented by the factor.

Results Related to Self-Efficacy

Items relating to self-efficacy were subjected to factor analyses which yielded one factor relating to each type of self-efficacy, *Personal Computing Efficacy* and *Instructional Computing Efficacy* (see Table 5 and 6).

Table 5.
Factor Analysis for Personal Computing Efficacy (PCE)

Standard	PCE
Apply knowledge of terms associated with educational computing and technology	.87
Operate a computer system and utilize software	.86
Apply productivity tools for professional use	.84
Use electronic technologies to access and exchange information	.81
Knowledge of ethical and legal issues relating to the use of technology	.74

Table 6.
Factor Analysis for Instructional Computing Efficacy (ICE)

Standard	ICE
Use educational technologies for data collection, information management, problem-solving, decision making, communications, and presentations within the curriculum.	.88
Foster the development basic technology skills	.88
Plan and implement lessons and strategies that integrate technology to meet the diverse needs of learners in a variety of educational settings	.86
The student will communicate through application software	.85
The student will process, store, retrieve, and transmit electronic information	.82
Identify, locate, evaluate, and use appropriate instructional technology-based resources to support Standards of Learning and other instructional objectives	.78
The student will demonstrate a basic understanding of computer theory, including bits, bytes and binary logic	.70

Predicting Instructional Computer Use from Skill, Support and Self-Efficacy

Three separate stepwise regressions were used to predict the three types of instructional computer use from measures of *Skill*, *Support*, and *Self-Efficacy*. The following statistics are reported in each table: the variable entered at each step, r, R, R^2, F, and FD.

Prediction of Traditional Instructional Computer Use.

Classroom Integration Training, *Time Support*, and *Peer Support* entered the regression equation with *Traditional Instructional Computer Use* (see Table 7). Teachers who reported having more integration training, more satisfaction with the time they are given to use computers, and more satisfaction with the collaboration they have among their peers related to computers were more likely to use computers for concept reinforcement. The R for this equation was .167 indicating that nearly 17% of the variation in the *Traditional Instructional Computer Use* was accounted for by these four variables.

Table 7.
A Summary of the Results of Multiple Regression Analysis to Predict *Traditional Instructional Computer Use* from the Predictor Variables

Step	Variable Entered	r	R	R^2	F	FD
1	Classroom Integration Training	.298***	.298	.086	26.7	26.7
2	Time Support	..251***	.366	.128	21.2	14.3
3	Peer Support	.237***	.409	.158	18.3	10.9

*<.05 **<.01 ***<.001 n=276

Prediction of Instructional Computer Use via Curricular Integration.

Instructional Computing Efficacy, Classroom Integration Training, and Access and Technical Support entered the regression equation with Instructional Computer Use via Curricular Integration (see Table 8). Teachers who reported having more instructional efficacy related to computers, more integration training, and more satisfaction with computer access and technical support were more likely to integrate computers into their curriculum. The R for this equation was .159 indicating that nearly 16% of the variation in the Instructional Computer use via Curricular Integration was accounted for by these three variables.

Table 8.
A Summary of the Results of Multiple Regression Analysis to Predict *Instructional Computer Use via Curricular Integration* from the Predictor Variables

Step	Variable Entered	r	R	R^2	F	FD
1	Instructional Computing Efficacy	.302***	.302	.088	27.4	27.4
2	Computer Integration Training	.296***	.378	.137	22.8	16.6
3	Access & Technical Support	.125*	.399	.159	17.2	5.3

*<.05 **<.01 ***<.001 n=276

Prediction of Instructional Computer Use as a Reward for Completing Work.

No variables entered in the equation with *Instructional Computer Use as a Reward for Completing Work* The use of computers as a reward for completing work is not related to personal or instructional efficacy nor is it related to satisfaction with support. It is also not related to the use of computers for non-instructional activities or to computer training.

Discussion of Results

The three types of instructional uses dominating the self-reports of teachers participating in the present study have been found in previous studies as well. According to Evans-Andris (1995) teachers exhibiting an Avoidance Orientation attempt to provide students with access to computers but try to avoid contact with both students and computers during this time. Such teachers who fit this description use computers as rewards for completing work. Becker (1991) also referred to this as a common use of computers in K-12 schools; however, it is the least desirable instructional use identified in the present study. Some may argue whether it can even be considered an instructional use. Traditional ways of using computers were frequently reported in the present study in agreement with numerous previous studies (Evans-Andris, 1995; OTA, 1995; Becker, 1994). Likewise, curricular integration was identified in the present study and has been sited elsewhere as the most effective instructional use of computers (Hill, Manzo, Liberman, York, Nichols & Morgan, 1988; Hurst, 1994; Maddux, Johnson & Willis 1997; Dwyer, 1994; Means & Olson, 1994; Singh & Means, 1997; Hawkins & Collins, 1992).

Teachers reporting both traditional uses and curricular integration reported having classroom integration training. While using computers in traditional ways has appropriate uses in the classroom, "these uses in essence use technology to do the same things that schools have traditionally done for students –albeit perhaps more systematically and efficiently" (Means, 1996, on-line).

The main difference between teachers reporting mostly traditional uses and those reporting curricular integration was their perception of their ability to use computers in instruction. This suggests that teachers' instructional efficacy related to computers is an important factor to consider when trying to help teachers use computers as an integral part of the curriculum. Similar results were obtained by Marcinkiewicz (1994) and Vockell and Sweeney (1994). According to Hadley and Sheingold (1993), self-efficacy related to instructional computer use fosters flexibility, experimentation, and multiple approaches to using computers in instruction.

Support was also a common factor for teachers reporting both traditional uses and curricular integration. Access and technical support was particularly important to those teachers reporting curricular integration while peer support and time support was particularly important to those teachers reporting traditional uses. At first glance this seems illogical since peer and time support intuitively seem more crucial to curricular integration than to traditional uses.

However, research shows that it takes time for teachers to become adept at integrating computers into the curriculum (Hadley & Sheingold, 1993; Becker, 1994). These studies also show that initial implementation involves traditional instructional computer uses. It is probable that teachers reporting traditional uses are in the beginning stages of instructional computer use and will, in time, progress to curricular integration. While this hypothesis cannot be confirmed; it can be supported by the fact that the school district has recently embarked on a plan to foster the curricular integration of computers, thus, many of their teachers will be in the initial implementation stages.

Likewise, literature suggests that teachers who integrate computers in the curriculum, have a strong system of peer support as well as time to plan lessons (Becker, 1994; Hadley & Sheingold, 1993). Since the district has recently adopted a plan to foster curricular integration it is probable that teachers reporting curricular integration are the district-wide leaders in instructional computer use. As early adopters, it is probable that they have attended educational technology conferences and collaborated with teachers from outside their building (Rogers, 1995). It is also probable that as more teachers in the district begin to integrate computers, these teachers' instructional computer use will also be enhanced via both peer and time support. However, at the present time, these teachers view access to computers and the availability of technical support as important to their instructional use of computers.

Implications for Inservice Teacher Preparation

Curricular integration has been sited as the most effective use of computers in instruction. Results from the present study, in combination with, related literature can be used to make recommendations that may help to foster effective instructional computer use via inservice teacher preparation programs.

Teacher Perception of Self-Efficacy Related to Instructional Computer Use

Self-efficacy is likely influenced by training (Abdel-Gaid et al., 1986; Ashton & Webb, 1986; Delcourt & Kinzie, 1993; Jorde-Bloom, 1988; Olivier & Shapiro, 1993). Consequently, training should be designed with a goal of developing instructional computer efficacy. Data from the present study suggest that a main difference between teachers who integrate computers into instruction and those who do not is self-perception of their ability to use computers in instruction.

Current technology advocates recommend that skills relating to applications that are content and grade level

specific should be emphasized during inservice teacher preparation. (*Education Week*, November 10, 1997; Center for Technology and Teacher Education, 1997; President's Panel on Educational Technology, 1997; Cooper & Bull, 1997; Bull, Gansneder, Short, Dawson, Nonis & Berg, 1996; O'Donnell, 1996; Hurst, 1994). Likewise, inclusion of exemplary computer-using teachers as instructors for classroom integration training may foster the development of instructional computing efficacy via modeling. Because successful teachers are similar to inservice participants, participants' beliefs that they can successfully implement the strategies presented will tend to increase (Bandura, 1977).

Becker (1994) reported that the presence of other computer using teachers was the factor that most heavily influenced exemplary computer use. Participants in inservice computer training should be selected so that cadres of computer using teachers are formed within schools. Such cadres encourage collaboration and more effective problem solving (Moursund, 1989).

A Systemic Approach to Inservice Teacher Preparation

In the present study satisfaction with access and technical support is related to integrating computers into the curriculum. Teachers should be provided with technical support during and after inservice computer training. Teachers should also be provided with easy access to computers that can be used both for instructional and preparatory uses. Fostering such conditions implies that a systemic approach to inservice preparation may be most effective. A systemic approach to inservice technology preparation should provide collaboration between those conducting the inservice preparation and building level administrators and include both short range and long term goals.

Future Directions

Similar studies are being conducted in this district with middle school and high school teachers. Related studies involving direct classroom observation and teacher interviews are also being conducted to determine factors that may influence effective instructional computer use.

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INTERNAL CONSISTENCY RELIABILITY FOR THE TEACHERS ATTITUDES TOWARD INFORMATION TECHNOLOGY (TAT) QUESTIONNAIRE

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The Teachers' Attitudes Toward Information Technology Questionnaire (TAT) was developed during the second phase of the 1995-97 Matthews Chair for Research in Education Project at the University of North Texas. During Phase I (1995-96) activities focused on developing a more parsimonious instrument to assess the areas covered by 14 previously validated computer attitude scales. The result of that effort was the Teachers' Attitudes Toward Computers questionnaire (TAC) (Christensen & Knezek, 1996; 1997).

During 1996-97 construction of the TAT was begun to address areas not covered by the TAC. These were primarily areas that have come to be known in Europe as the New Information Technologies (NIT) — multimedia, electronic mail, and the World-Wide Web (WWW). In addition to the NITs, other areas, such as the use of information technology to improve teacher productivity, were also included because previous analyses indicated they might be important. Two well-validated subscales from the TAC were also included instrument for comparison purposes: a) Kay's semantic perception of computers (Kay, 1993) and b) D'Souza's (1992) classroom learning via Email.

Refinement of the TAT is ongoing. In this document internal consistency reliabilities are reported for the first large-scale pilot test of the instrument.

Subjects

The subjects in this study were 147 teachers from six schools in a large, urban public school district in northern Texas. TATs were completed during May of 1997. This was the last month of the 1996-97 school year in Texas.

Data Acquisition, Preparation, and Analysis

Data were gathered for 10 separate indices from the respondents. Eight of these ten subscales were newly constructed using semantic differential items taken from Zaichkowsky's (1985) Modified Personal Involvement Inventory, a context free 16-item semantic differential scale that focuses on "a person's perceived relevance of the object based on inherent needs, values, and interests" (p. 342) (see Figure 1). Semantic items were hand coded with a number from 1-7, representing the particular space the respondent marked between the adjective pairs, then keypunched by the University of North Texas Computation Center data entry staff. Cronbach's Alpha was produced for each subscale using SPSS on a Macintosh computer.

To me, Electronic Mail is:

important	_ : _ : _ : _ : _ : _ : _	unimportant
boring	_ : _ : _ : _ : _ : _ : _	interesting
relevant	_ : _ : _ : _ : _ : _ : _	irrelevant
exciting	_ : _ : _ : _ : _ : _ : _	unexciting
means nothing	_ : _ : _ : _ : _ : _ : _	means a lot
appealing	_ : _ : _ : _ : _ : _ : _	unappealing
fascinating	_ : _ : _ : _ : _ : _ : _	mundane
worthless	_ : _ : _ : _ : _ : _ : _	valuable
involving	_ : _ : _ : _ : _ : _ : _	uninvolving
not needed	_ : _ : _ : _ : _ : _ : _	needed

Figure 1. Sample Semantic Differential subscale from the TAT Questionnaire

Internal Consistency Reliabilities

As shown in Table 1, internal consistency reliabilities for the ten TAT subscales ranged from a low of .91 to a high of .98 (These reliabilities are based on responses from 74 subjects who furnished complete data). According to the guidelines provided by DeVellis (1991), this is excellent reliability for a research instrument. Additional strength is added to this conclusion because the two subscales carried over from the TAC exhibited internal consistency reliabilities quite comparable to the .93 (Kay's Semantic) and .95 (D'Souza's Classroom Email) found for these indices in the previous study of TAC reliabilities (Christensen & Knezek, 1997). The earlier study involved a much larger and diverse sample.

Table 1.
TAT Reliabilities for K-12 teachers from six Texas schools (1997)

Scale	# cases	# items	Alpha
Kay's Semantic (CAM)	74	10	.91
Email (teacher)	74	10	.93
Email (student)	74	10	.95
WWW (teacher)	74	10	.95
WWW (student)	74	10	.96
Multimedia (teacher)	74	10	.96
Multimedia (student)	74	10	.98
Productivity (teacher)	74	10	.96
Productivity (student)	74	10	.96
D'Souza's Email	74	11	.95

Future Work on Validity

Content validity for the TAT is believed to be quite high due to the way the instrument was constructed. Subscales were selected precisely because various scholars and practitioners in the field had identified these areas as important but not measured by previously-existing questionnaires. Construct (factor) validity needs to be checked through confirmatory factor analysis to see if some of the ten current subscales are not in fact duplicates of another. Criterion-related validity, such as the ability of the instrument to separate (discriminate between) groups thought to be different on one or more attributes, or the ability to measure pre-post change in a single group, needs to be established as well. Future research is planned in these areas.

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TEACHERS' ATTITUDES TOWARDS TECHNOLOGY

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Today's schools have heavily invested in computers and related technologies over the past decade. These technolo gies are playing important roles in education and training at many levels, such as multimedia, internet, world wide web, intranet, etc., are used to a greater extent. Future plans include networking computer technologies for whole- class viewing of computer information technologies. Resulting in most of the expenditure going to purchasing computers.

Between 1989 and 1992, schools' computer technologies have increased by nearly 50%, jumping from 2.9 million units to 3.5 million units (http:// www.access.gpo.gow/). Today, there are an estimated 5.8 million computers for instructional use. Although schools spent merely $ 3.3 billion on technology in the 1994-1995 school year alone, in many schools integration of the computers and related technologies into the classroom has been minimal, characterized by limited use of the technology as an add-on rather than as integrating to teaching and learning (Zappone, 1991).

One problem is that the growth of technology as an instructional tool is influenced by teachers' attitudes towards these technologies and their ability to use them successfully. While bombarded with promises of tomorrow's technology, many teachers are struggling to make efficient and effective use of today's technologies (Planow, Bauder, Carr, and Sarner, 1993).

Although the integration of all types of technology into the classroom is viewed as an effective instructional strategy for improving the students, many teachers often do not have favorable attitudes towards the effectiveness of technology (Huan, Compley, Williams, and Waxman, 1992; Padron, 1992).

Teachers' attitudes toward computers and related technologies can also influence students' attitudes toward technology. A number of studies have investigated teachers' attitude toward use of technology and anxiety about technology (Kay, 1989; Koohang, 1987; Marshall and Bannon, 1986).

It was found that teachers' attitudes towards technology has influence on the utilization of technology (OTA, 1988).Thus, teachers can not be assisted for providing relevant using and supported to integrate into curriculum, unless we do not know teachers' attitudes towards computers and related technologies as educational tools.

Speaking of the integration of technology into classroom, we can think how teachers are reoriented the terms of skills on technology. This is important since teachers are able to use all types of technology as an instructional instrument, and to feel comfortable with them before integrating into their daily teaching-learning activities.

Teachers' attitudes about technological innovation can significantly change the curriculum, teaching methodologies, and the roles between teachers and students. So, their attitudes should be improved positively toward the use of technology. If teachers are indeed to embrace technology and make it a part of their teaching culture, such as feelings, beliefs, values, etc., of their classrooms. In sum, if we know teachers' vision about technology we can learn their feelings about technology.

The purpose of the present study was to find out teachers' negative attitudes towards technology and to determine what kind of techniques that change their negative attitudes towards positive ones. It is expected that if elementary school teachers have positive attitudes toward technology, they may use novel technology more than before into their classrooms and integrate the use of the technology into classroom.

Participants

Twenty elementary school teachers (13 women and 7 men) who attend their graduation program in the University of Cincinnati, Teachers College volunteered to participate. However, researchers received only seven questionnaires from among these teachers.

Material

The questionnaire was designed gather data about teachers' attitudes toward technology based on theory of Planned Behavior by the researchers. The questionnaire had three sections that each has three questions.

The first section of the questionnaire was designed to find out and determine teachers' behavioral beliefs towards technology. In this section, the first question tried to find out the advantage of using the technology in the classroom, the second question tried to find out disadvantages of using technology in the classroom, and the final question attempted to find out what other factors influenced teachers attitudes towards using technology.

The second section of the questionnaire was designed to find out and determine teachers' normative beliefs towards technology. In this section, the first question tried to find out which people are the most important in influencing the teachers' attitudes towards technology, the second question tried to find out which people are the least important in influencing the teachers' attitudes towards technology, and the last question was used to find out whether another group influences or does not influence the teachers' attitudes towards technology.

The last section of the questionnaire was designed to find out and determine teachers' control beliefs towards technology. In this section, the first question tried to find out what the most influential factors are about technology for teachers, the second question tried to find out what the least influential factors are about technology for teachers, and the last question tried to find out whether there are other things that would influence the teachers beliefs towards technology.

Design and Procedure

The study had these steps: researching the literature; determining the positive indicators of teachers' attitudes towards technology; determining the negative behaviors/actions of teachers towards technology and the salient beliefs of teachers towards technology; designing the questionnaire; distributing and having them back; establishing the dimensions of behavior, normative and control items; tabling the model salient beliefs for behavior, normative and control beliefs; attempting to change teachers' negative attitudes towards technology by using operant conditioning theory and persuasive communication theory.

The Positive Indicators of Teachers' Attitudes Towards Technology

Researchers defined the positive indicators based on literature review and their personal experiences. They could find fifteen positive indicators to show teachers' positive attitudes toward technology. These are: Teachers would like reading magazines or books about technology; buying books about technology; watching technological TV series; using computerize materials; using computers; being in a situations where people talk about technology; using new technology versus old instructional materials; hearing information from my students about technological improvements; talking about technology with my colleagues; having new technology in my school; informing people about new technological development; encouraging people to use new technology; being member of technological associations or clubs; attending technological fairs; searching the Internet.

The Negative Behaviors/Actions of Teachers Towards Technology

Researches defined the negative behaviors/actions of teachers toward technology based on literature review, their personal experiences and defined teachers' positive attitudes towards technology. These are: Teachers do not use technology in their classrooms; encourage their students using technology; support technology buying schools; research on the Internet; use email in their daily lives; have a homepage on the World Wide Web; encourage their students surfing on the Internet; read any published things about technology; watch the science-fiction programs or movies on TV; prefer using traditional teaching methods into their classrooms; want to gain any information about technology; want to attend any in-service education program about technology; being the member of any technological associations or clubs; enjoy talking about technology with their colloquies; attend any technological fairs.

The Salient Beliefs of Teachers Towards Technology

The following items are determined as the salient beliefs of teachers towards technology based on the literature review and experts' opinions. They think that they will lose their authority in the classroom; are too old to learn new technology; see learning of technology extra load for them; afraid of being unsuccessful using technology; afraid of changing their roles into classrooms; will lose their jobs; do not want to attend training programs; as if they are students; are afraid of addiction to the Internet; will lose their status to be the first and unique sources of information; and they think that technology will replace them; brings alienation; creates uncertainty due to unknown results; reduces of the interaction among people; and learning new technology is the waste of time.

Responses to the Questionnaire

Researchers gathered information about the dimensions of behavioral, normative and control beliefs from the elementary teachers' answers

Each given answer was read, and then, the short sentences about teachers beliefs towards technology for three sections of the questionnaire were written by the researchers in order to find out the frequency distribution and percentage of each answer given by teachers.

Findings

The following items were gathered according to seven teachers' answers to the questions of the dimensions of behavioral, normative and control beliefs.

Behavioral beliefs are: save time; doing task efficiently; take more time; need to know how to use it; technology may not be as effective as teachers in instruction; bring the more current issue to the classroom; no enough computer to

use; to prepare students for future by using technology; to take over being the teacher; using technology need more money; rethinking and restructuring of teaching methods, class size, individualized instruction; to supply feedback easily to students; not all students respond well to computers; instructional technology is not prepared but also by others; increase self-esteem and competency; students feel good about what they can do; send journals via email; organize files; inventory class items (keep many things); relaying on computerized task taking programs to "do the job"; need to have reliable students and trust that they don't destroy program on cause damage to equipment.

According to "Model Salient Beliefs Table 1" for behavioral beliefs, the most important belief about using technology is to take more time. Doing task efficiently using technology is the second important belief in this section for teachers. "Need to know how to use it", "Rethinking and restructuring of teaching methods", and "Inventory (keeping) class items" are the least important behavioral beliefs for teachers attitudes towards technology.

Normative beliefs are: those who are using it; people who are not using it; media; politicians; principals; other teachers; parents; experts; school boards; students; community members; benefits of technology; environment, and professors.

According to "Model Salient Beliefs Table 2" for normative beliefs, experts and students point of views about technology are two most important beliefs about using technology for teachers into their classrooms. "People who are not using it", "Principals", "School boards", and "Benefits of technology" are the least important people or group for teachers.

Control beliefs are: media; students' interests; other teachers; in service training and seminars; the skilled students; availability of equipment; addition of objectives in the curriculum; to prepare students for future; to search for information; ease of teaching instruction; to be competent in using technology; to live comfortably with technology; coordination of curriculum; to believe that we can't live without it, and information and success in Ed/Tech journals.

According to "Model Salient Beliefs Table 3" for control beliefs, students' interests about technology are the most important belief about using technology for teachers into their classrooms. "In service training and seminars", "Availability of equipment" and "Search of information" are less important than students interest for teachers. However, they believe that these are important things to use for technology in the classroom.

The findings of this study can be listed as: technology takes more time; doing task efficiently; experts' opinions and students' interests are important for teachers to use into classroom or integrate into curriculum; teachers need in-service training and seminars about technology as an instructional tool; teachers need the support in terms of availability of equipment and searching of information about technology.

In sumary, teachers seem to have positive attitudes towards technology. Especially, students' interests and experts' opinions, encourage them to use technology. However, they need to support the use and integrating of technology in their classrooms. The seminars or in-service program can be designed for teachers to improve their attitudes or to change their negative attitudes towards positive attitudes.

Discussion and Conclusion

A number of studies have investigated teachers' attitudes toward the use of technology. In this study it was found that teachers seem to have positive attitudes towards technology. Students' interest and experts' opinions encourage them to use technology in educational settings. However, they need to encourage and support the integration of technology into the curriculum. The seminars or in-service training programs can be designed for teachers to improve their attitudes or to change their negative attitudes towards positive attitudes.

These findings are supported by related literature. The findings from the literature have also shown that: there is a significant difference between the attitudes of teachers and students who are from different countries towards technology; more computer experiences make people feel comfortable and have positive attitudes towards technology, on the other hand, having computer anxiety prevents people's positive attitudes towards technology.

It is important for us as educators to understand teachers' attitudes towards technology as an educational instrument for providing relevant technologies and integrating them in curriculum.

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Appendix 1

Table 1. Model Salient Beliefs For Behavioral Beliefs

Rank	Behavior	%	Frequency
1	[illegible]	28	[illegible]
2	[illegible]	21.4	3
3	[illegible]	14.3	2
4	[illegible]	14.3	2
	[illegible]	7.14	1
5	[illegible]		
6	[illegible]	7.14	1
	[illegible]	7.14	1
	[illegible]		

Table 2. Model Salient Beliefs For Normative Beliefs

Rank	Behavior	%	Frequency
1	[illegible]	21.4	3
2	Students	21.4	3
3	[illegible]	14.3	2
4	[illegible]	14.3	2
5	[illegible]	7.14	1
6	[illegible]	7.14	1
7	School boards	7.14	1
8	[illegible]	7.14	1

Table 3. Model Salient Beliefs For General Beliefs

Rank	Behaviors	%	Frequency
1	Students' interests	40	2
2	[illegible]	20	1
3	[illegible]	20	1
4	[illegible]	20	1

BEST COPY AVAILABLE

Technology Training Needs....A Validation Study

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To overstate the obvious...technology is upon on us and there would appear to be no end in sight. Educators must increase the use of technology in the classroom. To do this, educators from classroom teachers to media/technology specialists, to administrators, to college and university faculty must become aware of new technologies and be trained in their uses (Brownell, 1997; Dede, 1997; Paccione, McWhorter & Richburg, 1997; Parker, 1997). For the training needs of educators to be met, technology trainers must identify the competencies and skills for which educators have the greatest needs and then design programs which will meet those needs (Ferris, Roberts, & Skolnikoff, 1997).

The two previous studies, involving the surveying and interviewing of technology and media specialists in two school systems on the technology training needs of school personnel, were successful in identifying the current and future training needs of those systems (Mc Kenzie, Kirby, Clay & Davidson, 1997). This third study seeks to extend and refine (that is, validate) our ability to obtain training information on the technology uses of teachers and students as well as the training needs of teachers, especially those that are new practitioners.

Methodology

To extend and refine our ability to find out what the technology training needs of educators are, the instruments used in previous studies were revised for improved clarity; altered to include the use of a 5-point Likert scale response system; and expanded to incorporate open-ended, sentence completion items.

To validate the findings of the two previous studies, the redesigned instrument was distributed to additional school systems including the two previously involved systems through media specialists and technology trainers. Those participants that were part of the first two studies were either called on the phone for their responses to the validation survey or had face to face meetings with the investigators. New participants, consisting of media and instructional technology graduate students at the State University of West Georgia, were asked to complete the survey at the end of their class in a written format or respond electronically on their class listserv.

Analysis

Forty-one surveys were collected and analyzed by the research team. It was discovered that the majority of the respondents were from the high school level, had 1-5 years of experience in their position, served as lead teachers in technology in their schools, had a master's degree plus additional graduate work, and were female. Table 1 below summarizes the study's demographic data.

Table 1.
Demographic Data

School Level
- Elementary School - 13 (31.7%)
- Middle School - 9 (22%)
- High School - 19 (46.3%)

Years of Experience in Your Position
- 1-5 years - 15 (36.6%)
- 6-10 years - 6 (14.6%)
- 11-15 years - 3 (7.3%)
- 16-20 years - 8 (19.5%)
- 21 or more years - 9 (21.9%)

Current Position
- Media Specialist - 12 (29.3%)
- Technology Trainer - 1 (2.4%)
- Technology Coordinator - 3 (7.3%)
- Teacher - 23 (56.1%)
- Other - 2 (4.9%) (Computer Teacher, Technology Specialist)

Latest Degree
- Bachelor's - 12 (29.3%)
- Master's - 10 (24.4%)
- Master's plus grad credit - 13 (31.7%)
- Specialist - 5 (12.2%)
- Doctorate - 3 (7.3%)

Gender
- Female - 32 (78%)
- Male - 9 (21.9%)

Mean scores were computed for the closed-ended questions utilizing the 5-point Likert scale. The responses to each technology question within the study's three areas of interest, teacher use of technology, student use of technology, and technology training needs; were then ranked from the high to the low mean scores so that frequency could be identified. A five indicated that the item was used "very frequently" while a one stood for "not at all."

In examining how often teachers used specific technology equipment, mean scores ranged from a 4.61 to a 2.0. The most frequently reported type of technology was the overhead projector. This was followed by the use of computers for word-processing, videocameras, computers with multimedia development capabilities, and computers with Internet access. It was not surprising to find that three of the top five types of hardware dealt with the teacher utilizing the computer for classroom instruction.

On the software dimension mean scores ranged from a 4.46 to a 1.98. Respondents reported that the software they used the most frequently involved videotapes and word-processing computer programs. The next most frequently cited types of software were on-line encyclopedias such as Groliers and World Book, CD-ROMs, and on-line periodical databases. Running parallel to the hardware findings, four of the top five types of software used the most frequently by teachers were computer related.

The rank order findings of the types of technology hardware and software used by teachers are listed in Table 2 below. Only those items that had a mean score of 2.5 and above on the 5-point Likert scale are reported.

Table 2.
Teacher Use of Technology in Rank Order

	Mean	S.D.
Hardware Use		
1. Overhead projectors	4.61	.80
2. Computers with word-processing capabilities	4.57	.55
3. Videocameras	3.14	1.11
4. Computers with multimedia capabilities	3.12	.89
5. Computers with Internet access	2.95	.98
6. Opaque projectors	2.93	1.06
Software Use		
1. Videotapes	4.49	.71
2. Computer programs for word-processing	4.46	.81
3. On-line encyclopedias	3.71	1.22
4. CD-ROMs specific to content areas	3.54	.89
5. On-line periodical database (Newsbank)	3.05	1.34

Mean scores computed for student use of technology hardware and software ranged from a 4.19 to a 1.34 on the 5-point scale. Respondents reported that students predominantly used the computer for word-processing, multimedia, and Internet access. The software that was identified as being used the most often included word-processing computer programs, on-line encyclopedias, CD-ROMS, videotapes, and on-line periodical database. Table 3 highlights the rank order findings. Only the items that scored a 2.5 and above are listed.

Table 3.
Student Use of Technology in Rank Order

	Mean	S.D.
Hardware Use		
1. Computers for word-processing	4.19	1.05
2. Computers with multimedia capabilities	3.11	1.24
3. Computers with Internet access	2.93	1.25
4. Video cameras	2.78	1.01
5. Overhead projector	2.76	1.01
Software Use		
1. Computer programs for word-processing	4.28	.96
2. On-line encyclopedias	3.95	1.20
3. CD-ROMs specific to content area	3.65	1.19
4. Videotapes	3.18	1.19
5. On-line periodical database	3.08	1.56

Part three of the study used a 3-point response scale to examine the types of technology training needed by media specialists and incoming teachers and validated all of the listed training skills. On the 3-point scale, the mean scores ranged from a 2.70 to 1.85. A score of three indicated that "extensive training was needed" while a one represented "no training was needed."

The study found that the two most frequently reported types of technology skills needed by media specialists to be better prepared for entry into the schools were setting technology priorities for problem solving; designing and administering technology training sessions for teachers and administrators; and trouble shooting technology problems frequently occurring in the schools, especially computer related problems. The types of technology skills incoming teachers needed to be better trained in upon entry into school systems were demonstrating basic computer utilization skills in the classroom and being open minded about computer platforms so that both computer platforms can be used rather than showing preferences. Table 4 summarizes the training needs for media specialists and incoming teachers in rank order. Only those items scoring a 2.35 and above are listed

Conclusion

The results of this study should be used by teacher training institutions to examine their present technology training curriculum. Restructuring should take place where needed to ensure that current needs are mirrored in curriculum and that graduating pre-service and inservice students will take the lead in schools systems to better integrate technology into the curriculum.

Table 4.
Technology Training Skills in Rank Order

	Mean	S.D.
For Media Specialists		
1. Setting technology priorities for problem solving	2.70	.57
2. Designing and administering technology training sessions for teachers and administrators	2.63	.66
3. Trouble shooting technology problems	2.55	.60
4. Making minor equipment repairs	2.46	.60
5. Managing time more wisely during the day	2.46	.60
6. Integrating technology into the curriculum	2.41	.79
7. Administering and using GSAMS	2.40	.67
8. Designing and administering technology training sessions for students	2.40	.67
9. Being familiar with titles of outstanding software programs in specific content areas	2.38	.71
For Incoming Teachers		
1. Demonstrating basic computer utilization skills in the classroom	2.70	.56
2. Being open minded about computer platforms so that both can be used rather than showing preferences	2.64	1.53
3. Using technology innovatively to deliver instruction	2.63	.63
4. Utilizing electronic grading	2.56	.66
5. Demonstrating an awareness of the various learning styles and selecting technology for students' based on their individual styles	2.53	.68
6. Knowing and using a wide variety of technology software in the curriculum	2.50	.68
7. Understanding and using the automated card catalog	2.48	.68
8. Using the Internet for classroom instruction	2.45	.68
9. Securing equipment in the classroom	2.40	.67
10. Using the older types of technology in the classroom when needed	2.40	.70
11. Shooting and producing videotapes for classroom instruction	2.35	.66

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Better Staff Development Planning Using the Teaching with Technology Instrument

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The purpose of this study was to examine teachers' concerns, knowledge, and actual use of technology, and how these related to the level of technology at their school. The measurement instruments used in the study were the Computing Concerns Questionnaire (Martin, 1989) and the Teaching with Technology Instrument (TTI) (Atkins, Frink, and Viersen, 1995). The TTI has forty-six questions and can be analyzed through a bubble scanner, so that administration and analysis of the TTI can be conducted at the school or district level.

Literature Review

According to teachers, the school principal is a major stimulus for computer integration in the school (McGee, 1985; Hall & Hord, 1987; Knupfer, 1989). Staff development training helps to increase teachers' use of computers and helps to develop more positive attitudes toward computers (Hagey, 1985; Martin et. al., 1988). Hands-on training with peers is the preferred type of training (Johnson, 1988). Teachers give high ratings to software applications that allow them to manipulate information, such as word processing programs (Woodrow, 1991).

Teachers have many concerns about the use of computers in instruction. Some of these are: software, hardware; lack of time, training, and support; possible negative effects of computers on children or on the teacher's role in the classroom; and problems of curriculum integration (Aust, Allen, & Bichelmeyer, 1989; Callister, 1986; Cosden, 1988; Cumming, 1988; Knupfer, 1989; MacArthur & Malouf, 1991; Taylor, 1987; Vermette, Orr, & Hall, 1986; Woodrow, 1987).

Many staff developers in planning for change use the Concerns Based Adoption Model (CBAM) (Fuller, 1969; Hall & Hord, 1987). Martin (1989) used the CBAM mode to develop the Computing Concerns Questionnaire. Martin categorized teachers' concerns into eight Stages of Concern about Computing (SoCC): contextual; information; personal; management; consequence on self; consequence on others; collaboration; and refocusing. Using Martin's questionnaire, Bly (1993) found differences among teachers on SoCC and what they perceived to be good staff development. Teachers at low stages of concern rated structured introductory hands-on workshops, as being more effective than teachers at higher stages of concern. There were also differences in many demographic variables in relation to stages of concern.

Methods

Demographic questions, the Computing Concerns Questionnaire (Martin, 1989), and the Teaching with Technology Instrument (TTI) (Atkins, Frink, and Viersen, 1995) were administered to a sample of teachers at three middle schools in a large school district (N = 155). School One, with the lowest amount of technology integration of the three schools, was a rural school with no technology related goals in the school improvement plan, and no support personnel for technology. School Two was an urban school that had a technology grant and technology specialist in the past, but not longer had either. They had somewhat integrated technology into the curriculum. School Three, with the highest level of technology integration, was an urban inner city magnet school that had technology-related goals in the school's improvement plan, up-to-date computer equipment, and a technology specialist. Qualitative analyses also conducted will be discussed briefly.

Assessment Instruments

In addition to the two instruments discussed below, teachers were also asked to respond to ten demographic questions.

Through their responses to the Computing Concerns Questionnaire (Martin, 1989), individuals are measured with respect to their Stages of Concern about Computing (SoCC). Coefficients of internal reliability for different stages of the Computing Concerns Questionnaire ranged from .65 to .83

The Teaching with Technology Instrument (TTI) was developed to assess training needs for teachers in three areas: writing and communication, information awareness and management, and construction and multimedia (Atkins, Frink, & Viersen, 1995). The forty-six dichotomous choice (yes/no) questions relate to the basic computer competen-

cies recommended by ISTE and others (ISTE, 1992; Sheingold et al., 1990; State Board of Education, 1995). By tabulating a percentage score from this instrument, one can assess the three areas of technology use. The TTI can be answered on a bubble sheet and scanned for easy interpretation (Bubble Publishing Program, 1992). The scanned output displays a histogram of the responses (yes/no) for each item grouped by topic area and increasing level of difficulty. As Figure 1 illustrates, these histograms can be visually interpreted, and even color coded, to determine staff development needs within a given area. Cronbach's alpha (.9462) was used to establish reliability of the TTI.

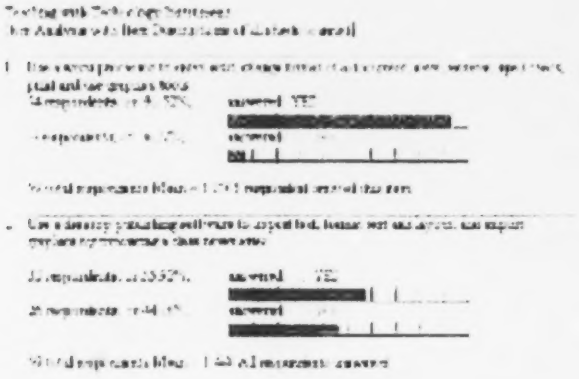

Figure 1. Partial Output from Analysis of TTI Using Bubble Scan Program

Dependent Variables

The eight Stages of Concern about Computing (SoCC) as measured by the Computing Concerns Questionnaire (Martin, 1989) are: contextual; information; personal; management; consequence on self; consequence on others; collaboration; and refocusing. The self-reported knowledge a teacher has regarding technology was measured by the TTI. The TTI total score for an individual ranged from 0 to 46.

Independent and Control Variables

The independent variables for this study were age, computer confidence level, gender, home access to computers, level of college education, numbers of hours of technology training during the past two years, school access to technology, subject taught, and teaching experience. They were measured through a demographic questionnaire. One control variable was used in this study, level of technology integration at the school.

Hypotheses

1. There will be a significant positive relationship between the Stages of Concern about Computing (SoCC) and the total score on the Teaching with Technology Instrument (TTI).
2. There will be a statistically significant positive relationship between the Stages of Concern about Computing (SoCC) and each of the independent variables: age, computer confidence level, gender, home access to computers, level of college education, number of hours of technology training during past two years, school access to technology, subject taught, and teaching experience.
3. There will be a statistically significant positive relationship between the Teaching with Technology Instrument (TTI) and each of the independent variables (see Hypothesis 2).
4. Teachers at schools with higher levels of technology integration (Schools Two and Three) will have overall higher mean scores on the TTI than teachers at School One. In addition teachers at Schools Two and Three will report more usage of technology, and demonstrate that behavior in their classroom.

Statistical Analyses

In order to address the first research question a Spearman rcorrelation coefficient was calculated between the Stages of Concern about Computing (SoCC) score and the Teaching with Technology Instrument (TTI) score.

To answer the second research question, the appropriate measure of association was calculated between SoCC score and each of the independent variables: age, computer confidence level, gender, home access to computers, level of college education, number of hours of technology training during past two years, school access to technology, subject taught, and teaching experience. The measures of association and accompanying statistical test conducted depended on the level of measurement of the variables: ordinal with ordinal, Spearman and test of association; ordinal with categorical, Contingency Coefficient (C) and Chi SquareTest of Independence. An alpha level of .05 was used for all statistical tests.

The third research question was answered by calculating a measure of association between TTI score and each of the independent variables: age, computer confidence level, gender, home access to computers, level of college education, number of hours of technology training during past two years, school access to technology, subject taught, and teaching experience. The measures of association used were: interval with ordinal, Spearman r; interval with dichotomous, point biserial r. Since TTI was interval, a single factor anova was calculated on the TTI score for each independent variable for which a significant relationship was found. An alpha level of .05 was used for all statistical tests.

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Results

SoCC and TTI

A statistically significant positive relationship was found between the SoCC and TTI scores (r = .322, p = .0001).

Demographic Variables

SoCC score was significantly related to computer confidence level (r = .332, p = .000), and number of hours of technology training (r= .224, p = .005). No other significant relationships were found.

A significant positive relationship was found between TTI score and each of the following variables: age (r = -.224, p = .005), computer confidence level (r = .651, p = .000), home access to computers (r = .267, p = .001), number of hours of technology training (r = .199, p = .013), and school access to computers (r=.291, p = .000). One-way Anovas conducted on TTI for each of the following variables were significant: levels of computer confidence ((F(3,150)= 44.00, p = .0001); home access to computers (F(1,152)= 11.69, p = .0008); and school access to computers (F(1,152)= 14.07, p = .0003). The mean TTI scores for these variables are shown in Table 1. No other significant relationships were found.

Table 1.
Mean Teaching with Technology Score For Variables Correlating Significantly with TTI

Independent Variables	M	SD	n
Computer Confidence Level			
Nonuser[a]	10.57	8.79	7
Novice[b]	11.92	9.49	61
Intermediate[bc]	20.85	11.02	59
Experienced[abc]	37.52	8.28	27
Home access to computers			
No[d]	14.28	10.33	46
Yes[d]	22.10	13.96	108
School access to computers			
No[e]	12.16	11.66	32
Yes[e]	21.76	13.19	123

Pairs of means with the same superscript, for example [a], are significantly different, Scheffe, p<.05. Only independent variables for which a significant association was found are reported.

School's Level of Technology Integration

A one-way Anova revealed significant differences between the mean TTI total scores of School One (M = 12.00, SD = 10.95, n = 57), School Two (M = 18.42, SD = 13.08, n = 39), and School Three (M = 26.31, SD = 12.23, n = 59) (F(2,151)=.16.45, p = .0001). All means were significantly different from each other (Scheffe, p = .05) (see Figure 2). As predicted the schools with more technology integration had teachers with significantly higher mean TTI

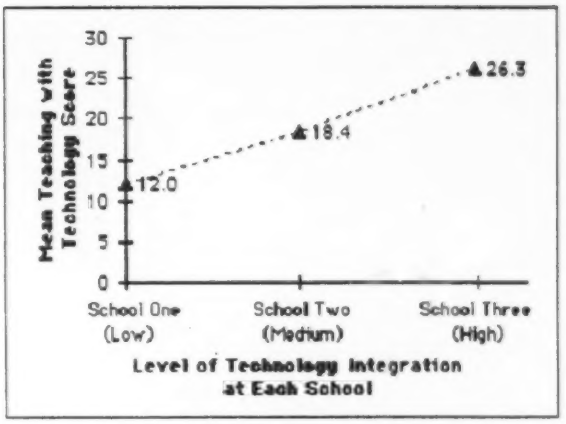

Figure 2. Means of the three schools displayed according to their level of technology integration.

Follow-up interviews and observations were conducted on twelve teachers. At School One, teachers were at lower levels of concern, and little technology was being used in instruction. School Two previously had a technology grant, but now had no extra funding or personnel. Two of the teachers were at higher stages of concern. The computer lab was closed for remodeling, so no classroom observation took place. These teachers wanted to use more technology, but expressed frustration about the lack of coordination. School Three was the most technologically advanced with a full time technology specialist. Classes incorporating technology occurred everyday. The school offered technology training to all their staff, and had more technology resources available for use than at the other schools. The principal made the use of technology a priority for the school, and every teacher had a computer in the classroom.

Discussion

Teachers at higher stages of concern about computing (SoCC) tended somewhat to have higher mean scores on the Teaching with Technology Instrument (TTI). The Spearman coefficient, although significant, was not strong (r = .322, p = .0001). This relationship probably cannot be perfect, since the SoCC score is subject to change as new technologies are introduced to teachers. As teachers become more knowledgeable about technology, their concerns tend to move to higher levels (consequences on self and others).

Computer Confidence Level

A teacher's computer confidence level is strongly related to knowledge and use of technology in teaching (r = .651, p = .0001). The relationship between confidence level and stage of concern about computing is somewhat weaker (r = .332, p = .0001). Even though a teacher might be competent in basic word processing, the introduction of a new technology might return them to more lower level

informational concerns until they acquire the new competencies.

Number of Hours of Technology Training

The number of hours of technology staff development a teacher had was significantly related to SoCC score (r = .224, p = .005). Generally, teachers with more technology training are at higher stages of concern.

A weaker, but statistically significant relationship exists between number of hours of technology staff development and TTI scores (r = .199, p = .013). This correlation indicates that attending many hours of technology training does not completely ensure acquisition of computer knowledge. Other factors must be in place in order for teachers to integrate computers into the curriculum.

Age

There was no relationship between a teacher's age and the Stages of Concern about Computing. However, age was related negatively to TTI score (r = -.224, p = .005). Younger teachers tended to score higher. This may be a reflection of the changes in preservice teacher education. (Nicklin, 1992).

Access to Computers

No relationship existed between Stages of Concern about Computing and home access to computers. Even though teachers may have a home computer, they may not use it for school instructional planning. However, home access was significantly related to TTI score. Teachers with a home computer scored almost eight points higher on the TTI (M = 22.10) than those without (M = 14.28).

Teachers who have computers and technology equipment at school did not have higher SoCC scores than teachers with no access. Even if teachers have technology at school, they may not use it. However, school access was related to TTI score. Teachers who have technology equipment readily available in their schools had higher mean TTI scores (M = 21.76), than teachers who did not (M = 12.156). Having school access to technology helps teachers to learn to use it and integrate it into instruction.

School's Level of Technology Integration

Schools with more technology integration had teachers who had significantly higher mean TTI scores (see Figure 2). This suggests that schools that have technology support can progress further its use in instruction. For these three schools, those that received more technology support had more technology integration. This suggests that if we are to use technology in schools effectively, a school level technology specialist should be present for technical support and staff training.

The Stages of Concern about Computing distributions for the three schools are displayed in Figure 3. Schools with higher levels of technology integration tended somewhat to have teachers with more advanced levels of concern

Conclusions

Looking at the three schools in this research study, School Three had funding, supplies, technology support personnel, and a principal who strongly advocated technology integration. Schools Two and One did not have current equipment, or a school technology specialist to implement ongoing technology staff development and support for teachers. If a technology program is to succeed, there should be a clear vision of technology-mediated education, strong administrative backing, an adequate budget, good supplies and equipment, consistent expectations, and a clear evaluation system. The findings of this study seem to indicate that schools that have technology specialists have a better chance of achieving the integration of technology into the curriculum.

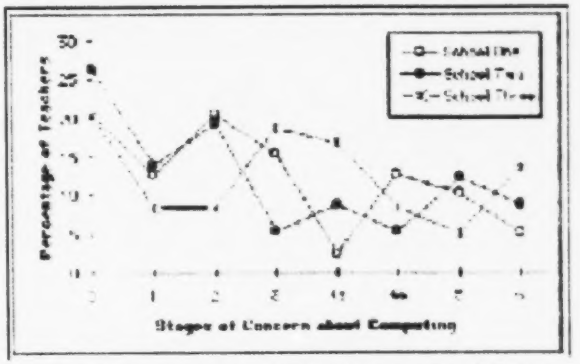

Figure 3. Percentage of Teachers at Each Stage of Concern about Computing. Level of Technology integration: School One, low; School Two, Medium; School three, high.

Change carries major ramifications for schools as the use of the technology becomes more prevalent. Knowledge of teachers' stages of concern, and their knowledge and use of technology in instruction may help planners provide effective staff development activities. This knowledge, in turn, can increase the likelihood that resources committed to instructional computing will lead to successful integration. The Computing Concerns Questionnaire requires sophisticated analyses. Since the SoCC score and TTI score were significantly correlated in this research, the TTI may be useful to schools in order to better plan technology related staff development activities.

The TTI assesses self-reported knowledge and use of technology in the classroom. A typical bubble scan program can be used to produce histograms for the different areas on the TTI. A principal could use the TTI to get a school profile identifying areas where technology training is needed, and individual teachers could receive a profile of their technology competencies in relationship to the whole school. The TTI needs further testing to assess its capability as a tool to assist administrators in planning for staff development. The result could be more appropriate staff

development activities for teachers, and hopefully a corresponding increase in the effective integration of technology into schools.

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The Meaning of Technology: A Model For Understanding Technology Adoption1

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This paper reports on a study that investigated the issue of technology integration from an angle that has been traditionally ignored in mainstream research on educational applications of technology. The fundamental question here is why teachers use or do not use technology. Most researchers have been seeking the answer by looking for external factors and individual differences that lead to the use or non-use of technology. The result is a long list of both internal and external factors, ranging from technical skills to the availability of educational software (Cuban, 1986; Miller & Olson, 1994; US Congress Office of Technology Assessment, 1995)). Drawing on a psychological theory known as Perceptual Control Theory (PCT) (Cziko, 1995; Powers, 1973), the present study took a different approach. It sought to understand why teachers use or do not use technology in their teaching by looking into their perceptual world instead of the environment. Rather than trying to identify factors that may be responsible for a teacher's use of technology, this study attempted to depict the mechanism that teachers use to construct and change the meaning of technology for their lives, which then determines whether and how they use technology.

Research Context

Historically, teachers have not responded to technology innovations as enthusiastically as expected by technology advocates (Cuban, 1986)), resulting in only spotty instead of wide-spread uses. As the Office Technology Assessment (OTA) (1995) reports, "despite over a decade of investment in educational hardware and software, relatively few of America's 2.8 million teachers use technology regularly in their teaching." Thus in order to achieve universal adoption, substantial efforts are being made to ensure that teachers use technology in their teaching. Essentially, the efforts come in two forms: pressure and training. First, tremendous amounts of social, psychological, and even economical pressure are being applied to both preservice and inservice teachers in the forms of technology competency requirement in certification, technology use as part of performance evaluation for tenure and promotion, and the promotion of the idea that teachers who do not use technology will soon become unemployable (OTA, 1995). Second, teacher preparation institutions, school districts, and businesses have begun to provide a variety of training programs to increase teachers' technological knowledge and skills (OTA, 1995).

Underlying these efforts is the assumption that if teachers are required and prepared to use technology they will do so. The assumption, however, is not supported by research findings. Cuban (1986), for instance, found that "token compliance is a common response" to mandates that are incompatible with teachers' goals and beliefs (p. 55). While it is true that training may increase teachers technical skills and understanding of technology, there is little evidence suggesting that increased knowledge and skills result in increased and more effective use of technology. Available evidence suggests the opposite. Technology users are not necessarily more technologically advanced than non-users to begin with (Miller & Olson, 1994). Rather, their knowledge and skills increase as a result of using technology.

The flawed assumption is the result of insufficient understanding of the process whereby teachers interact with technologies. In spite of the widespread recognition of the central role of teachers in the effective use of technology (Cuban, 1986; OTA, 1995), "there has been relatively little research on how and why American teachers use technology" (OTA, 1995, p. 51).

Those few studies which have examined technology and teachers have all invariably taken a "net-casting" approach (Runkel, 1990) in that they attempted to identify and establish an exhaustive list of factors that may affect technology use. The focus is generally on the environment. Cuban (1986), for example, explains "teacher use of machines in classrooms" by examining environmental factors such as school and classroom structures. Researchers for the OTA report suggest that environmental factors such as time, technical support, and system incentives influence teacher use of technology (OTA, 1995, chap. 4). This

approach is problematic in a number of ways. Most serious is its failure to recognize teachers as purposeful human beings who act on their environment to achieve their own goals (Zhao & Cziko, 1996). Drawing upon previous research findings and based on a much under-utilized psychological theory known as Perceptual Control Theory, the present study examined teacher use of technology by looking into the teachers' perceptual instead of environmental world.

A Perceptual-Control-Theory Perspective on Technology Adoption

Perceptual Control Theory is a model of behavior based on control theory (for details of the theory see Powers, 1973). Essentially, PCT maintains that human beings have internal goals which they strive to reach. As control systems, human beings act to keep their perceptions in synchronization with these reference conditions. We do this by acting on our environment, producing effects which, when combined with prevailing circumstances of the environment, produce the desired perceptions. Human goals are hierarchical. In order to maintain a higher-level goal, it is necessary to vary lower-level goals. In other words, lower-level goals serve as means to achieve higher-level goals (Cziko, 1995; Powers, 1973).

The most important implication PCT has for research on technology adoption is the assumption that the decision to use or not to use technology is completely made by individuals based on the two interwoven concepts which distinguish this model from others: perception and hierarchy of goals. First, focusing on perception, this new model suggests that the decision is the result of subjective rather objective decision-making processes. An individual will use technology only when it is perceived as a way to achieve a certain goal or a number of goals at a high level. In other words, the use of technology must have clear "benefits." But while this is a necessary condition, it is not sufficient, because a person may have multiple but conflicting goals at the same hierarchical level. While the use of technology may meet some goals, it can also have "costs"—it can impede or disturb other goals. The individual will then need to make choices based on the importance of the conflicting goals, often factoring in the role of the various goals in achieving even higher level goals (Zhao & Cziko, 1996).

This leads to a disarmingly simple model of technology use: the degree to which a teacher uses technology (or any innovation for that matter) depends upon his/her perception of its relationship to the goals s/he tries to achieve. In other words, teachers judge any change on two dimensions: costs and benefits. For a teacher to use technology, the perceived benefits (potential to meet higher-level goals) must exceed the perceived costs (potential to disturb higher-level goals). For example, although one can learn to access the World Wide Web in about 5 minutes, many teachers believe it would take much more time. That perception can prevent them from using it because taking that time could mean giving up other goals, such as preparing for instruction, meeting with students, or spending time with their families.

"Perceived benefits" imply that whether or to what extent one uses technology depends on personal understandings about whether or to what extent the use of the technology helps meet important individual goals. For example, one of the perceptions that fuels the current push for educational uses of the Internet is that it can engage students in authentic tasks. Unless a teacher believes that the Internet offers a way to more effectively accomplish goals that were already part of her current practice it is unlikely that she will use it. Of course, the use of Internet might be perceived to meet other goals: to maintain the image of being professionally progressive and a life-long learner, for instance. Similarly, "perceived costs" refers to each individual's perception of the amount of disturbance the use of a technology may cause to other goals.

At this point, we must emphasize that both the construction and pursuit of hierarchy of goals and the process of determining benefits and costs is not necessarily rational and logically carried out. In fact, it is very often intuitive and even irrational. Moreover, costs and benefits are not always physical. They are often psychological and emotional. For example, a teacher may decide to use a certain technology because it enhances a self-conception of being a professional who is on the cutting edge. On the other hand, a teacher may not use technology simply because the possibility of being embarrassed in front of his students by having trouble operating the computer may threaten his self-perception as a competent professional in control of the teaching environment (OTA, 1995).

Research Questions

The issue of central interest in this study, then, is teachers' perceptions of technology. Specifically, the study was intended to answer the following questions:

1. What are teachers' perceptions of the educational uses of technology in terms of costs and benefits? Are teachers' perceptions different from those of school administrators, technology supporting staff, and parents?
2. How do teachers construct their perceptions? What are the sources of these perceptions?
3. In what way do teachers reconstruct and change their perceptions?

Project Description

At the beginning of 1997, the researcher initiated discussions with two local administrators who were interested in helping their schools move forward with technology integration. A project was designed in which a

volunteer group from each school composed of personnel who had expressed interest in learning more about technology would come together four times over a period of four months to interact around the ideas and issues of incorporating technology into their schools and classrooms. The intention of the researcher was that the project would begin with a series of interviews which he and an assistant would conduct with each of the participants. This would be followed by four sessions which would consist of a hands-on activity in which all participants would have an opportunity to experience some interaction with technology assisted by graduate students, followed by a discussion among the participants which would center around the educational possibilities and issues relative to classroom use of that technology. After the completion of the four sessions, the researcher and assistant would conduct exit interviews with all the participants.

The two schools represented widely different educational contexts. Fairview is a middle to upper middle class suburban town approximately five miles from a major midwestern city. The affluence is reflected in the quality of the school system. The test scores, always an important indicator of success for government officials, bureaucrats, and as well as parents and prospective homeowners, are consistently among the top in the state. The middle school itself is a new, clean and attractive building with wide hallways, spacious and seemingly well-equipped science labs, and a library/media center featuring a large glass-roofed reading bay overlooking the lawns. With regard to technology integration, however, the picture becomes complicated. The community has registered its support for technology in the schools by passing a bond issue for approximately 5 million dollars. In spite of the obvious community support, in spite of rhetoric supporting the vital role of technology in education teachers report that the first dollar of the bond money has yet to be spent and the district technology committee has been disbanded. No computers have gone into classrooms; no connections have been wired in. The lack of action by the district administration has caused the teachers to lose hope that the administration is committed to supporting technology advancement.

It is hard to imagine a school more different from Fairview Middle School than the Cultural Resource Center. This elementary school is a magnet school in an urban school district. It enrolls approximately 400 students in K-5. Plans call for adding 6th grade next year and 7th and 8th grade in the two subsequent years. The building is an older square brick structure in a section of mostly neat but very modest homes is being used beyond its capacity and the planned expansion will require either a move or an addition to the present facility. It is not a neighborhood school; students apply to come and are bussed from other areas of the city. Nearly all the students qualify for the government free lunch program. A high percentage of the students are from bilingual homes; many of the families are immigrant families in which the parents speak little or no English. The school prides itself on serving the interests of a multi-ethnic, multi-lingual population in a variety of ways. The name, the Cultural Resource Center is a clear signal that it chooses to present itself as more than just a typical 9-2:30 elementary school. Examples of the broader service mission is the field trip program for parents who are new to the community and perhaps the country and the parent-teacher association whose meetings are conducted with simultaneous translation into 7 different languages. The school includes a computer lab to which all students go at least twice a week. In addition, each classroom has one or two computers. The staff includes a full-time computer person who teaches the classes in the lab and trouble shoots for the teachers' classroom computers.

Participants

The groups

The Fairview group was made up of six teachers, all but one of whom had extensive experience, the library/media person, the school secretary, an assistant principal, two mothers of students, and the principal, Kathy. The teachers in the group were middle class, white, and very confident, exhibiting the independent spirit so often typical of teachers. They generally lived in the community and took pride in the good reputation of the school. They were lively and opinionated. They valued their time and were not hesitant to express whether they felt it was being well used by participating in the project. It was at all times clear that they would not participate unless they felt it were beneficial to them.

The CRC group, in contrast, was composed of two teachers, four paraprofessionals, and the administrator, Gina. The teachers were quite young, having less than five years of experience each. The groups was much more clearly willing to be led by the administrator's goals than the Fairview group. Three of the four instructional assistants were also parents of students in the school and so brought a dual perspective. They all expressed a strong enthusiasm for the school program and an equally strong desire for the school to help their children do more with computers. One said, "I don't want [my daughter] to be held back. I want her to know more than we do in school. "

Results

Semi-structured interviews were conducted among 18 teachers, teaching assistants, school administrators, and parents. Each interview lasted from 30 to 40 minutes. While specific questions were not exactly the same for each interviewee, the interviews centered around the following questions, which were designed to support the primary research questions:

1. What do you think about the role of technology in education?
2. In what ways and for what reasons do you currently use technology?
3. What kinds of experiences have you had learning about technology?

Although the groups were considerably different both in makeup and in the school/community contexts from which they came, the attitudes and perceptions revealed by the interviews showed some remarkable consistencies. In examining the data from the perspective of the three questions identified above, issues of costs and benefits surfaced.

These interviews revealed that:

- Teachers, administrators, and parents share a common perception of the use of technology in education at a generic level: technology is useful and compelling. However, perception of the costs and benefits associated with this infusion differed quite widely.

Without exception, all participants were emphatically certain that education needs to bring technology to students. All the teachers felt strong pressure to learn more about technology in order to serve students. This pressure did not come from the school district but from their certainty that technology is an inevitable part of life, will continue to become more important, and "the kids need to learn to use it." Which technologies, what exactly kids need to know about technology, and what purpose technology expertise will serve in education and life was not clear and did not seem to draw much of their attention. Perceptions of costs and benefits varied quite widely across the participating groups of parents, teachers, and administrators. Perceptions of costs expressed by the administrators tended toward actual financial costs for equipment and training time, and their perceptions of benefits tended to be focused on school or district benefits. For example, the CRC administrator had a goal of having the school develop expertise with video broadcasting:

- A video kind of thing—more collectable kind of thing. It makes it more meaningful if you have something to keep and show. I'd like to see more —b-channel. When we have fiber optics we could broadcast to the district. We could be a resource for the whole district.

Teachers' perceptions of costs and benefits were primarily focused on the contexts of their own lives, classrooms, and students. All teacher participants who referred to disadvantages associated with technology identified time they would have to take from their already hectic schedules to learn new technologies as the primary and significant cost.

Another difference in perceptions among the groups was revealed by opinions of the "benefits" and "costs" of educational uses of e-mail. Parents viewed it as a valuable tool to have access to teachers. However, several teachers perceived it as potential invasion of privacy and "taking school work home" because they would be expected to respond to any and all parents' emails.

Each individual in the project had found some small niche of technology use which felt comfortable to him or her and which seemed to provide clear benefits which had meaning for his or her professional life.

This niche functioned as a safe base from which to gradually expand their skills. One teacher at Fairview had found her niche in setting up a computer grading system to which she was very committed as an important tool for developing student responsibility. That such a decision is an interplay of costs and benefits is indicated by the following exchange (R=Researcher, T=Teacher):

R: Grade manager changed your way of grading, expanded your way of thinking about grading?

T: Keeps me on top of it. I look everything over every week. There was some games playing with the students, saying: I didn't know what my grade was—this makes the kids more responsible. I want to find a program that works better for me, for the extra credit. I'm very quick on keyboarding so its quick to do.

R: Are there any downsides?

T: Duplication. I keep it in a book so it's double work. The office wants a book. I like to show every piece of work. But the computer does all the calculation. So if the kid says why did I get a zero, the book shows the title of the worksheet.

R: Do many people feel like this is a good idea?

T: I survey the students at the end of each semester... they say they like having access to the grades. I have had some colleagues say they couldn't get it to work.

A teacher at CRC had encountered an elementary math program and found it fit her goals and teaching style. A teacher at Fairview had found that Adobe Pagemaker transformed her task of developing the student yearbook. Each of these individuals was interested in learning more technology, in expanding on the knowledge and experience he or she had, but in ways related to a self-defined comfort zone. Although the specific benefits perceived by these teachers varied widely, from pedagogical to practical, this method seemed to provide a way to provide a general benefit—increased technology use—while minimizing costs associated with such change.

Teachers were only interested in learning about technology applications which they perceived to have

direct professional or personal application. This finding was clearly connected to the primary cost teachers expressed about technology adoption—the time it takes from their limited resources.

This finding was based on the teachers' comments about the choices they made for the hands-on sessions of the research project, on reports of frustrations with workshops and classes they had attended, and on the difficulty of getting them to engage in theoretical discussions about implications of technology for teaching and learning. One CRC teacher, in response to the focus on developing a technology plan in the research project discussion sessions said:

I understand that we have to create the technology plan for the school. That would be. . well I guess that would be a fine outcome, but to be honest, more knowledge about what I could do with my kids now, or how the tech plan will help me figure out what to do in my classroom.

Similarly, although the Fairview teachers were very interested in the hands-on exploration sessions for the purposes of finding out "what's out there" as a research process for discovering classroom resources, they were unwilling to spend time in sessions which they did not believe fit their specific needs.

Teachers valued learning about new technology uses from each other—by observation and through casual conversation and were willing to teach other staff about a technology use which they found personally satisfying.

This attitude seemed to be true of both groups in the project. However, it was much more strongly voiced by the Fairview group. It is interesting that one of the contexts which they reported to be valuable was the ride to and from the university for meetings. This provided a time for informal professional interaction which they had not previously experienced. The CRC group, in contrast, participated in a structured discussion and then went their own ways. It is possible that peer support in technology learning is vital and can occur best when time is spent together around technology in non-structured settings. The value of this informal interaction to these teachers is an important finding.

All the teacher participants were willing, even eager, to help someone else learn what they already knew and considered valuable. Nearly all of the participants considered themselves beginners at technology use, but felt that if they new how to do a certain thing it must certainly be easy enough for others to learn and they were willing to share.

Summary

These findings suggest an entirely new model for enabling teacher learning of technology, a model which is teacher-driven rather than district-designed, which is based on making time and resources available for teachers to experiment with technology on their own terms, and which includes finding ways to enable teachers to interact with each other informally about personally satisfying and effective technology uses. Essentially, such an environment should enable teachers to change their perceptions of the benefits and costs of using technology in their teaching.

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Different Computer Attitudes between American and Chinese Students

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Research findings have suggested that student's computer attitudes tend to influence both their learning and achievement (Freedman & Liu, 1996; & Liu, 1997) with regard to computer mastery. It has also been shown that students with different ethnic backgrounds have different attitudes toward computers (DeVillar & Faltis, 1991; Freedman & Liu, 1996). As computer education has become an issue in many countries around the globe, the examination of student attitudes relating to computers and their use has become a topic for research. Of particular interest is the examination of possible differences in attitude among students from various countries and cultures. A number of studies have been conducted where American students have been compared to students of other countries (Martin, Heller, & Mahmoud, 1992). There is, however, a paucity of information on this topic relating to Chinese students. It is well documented (Stevenson, 1992; & Johnson & Liu, 1996), that the Chinese educational system is extremely unique, particularly in its attainment of high student motivation and exceptional work ethic.

A review of the literature suggests that studies comparing cross-cultural differences in computer attitudes have used a variety of variables to make comparisons. Such variables include: (a) the degree to which students enjoyed using a computer (Cooper & Stone, 1996; Temple & Lips, 1989; King & Bond, 1996), (b) the degree of motivation students have to learn and use the computer (Kellenberger, 1996; Clarian, 1 993, (c) the extent to which students see learning and using the computer as important (Pelton & Pelton, 1996; & Corston & Colman, 1996), and (d), the degree to which students experience anxiety while using a computer (Liu, 1997; King & Bond, 1996; Ayersman, 1996). The literature suggests that all of these variables are related to student learning with and about computers.

For purposes of this study, four variables have been identified from the literature. The four variables are: (a) enjoyment, (b) motivation, (c) importance, and (d) freedom from anxiety.

In this study, American and Chinese students were compared on these four variables. These four variables were also employed as the predictor variables in detecting the relationships between attitudes toward computers and computer achievement for both American and Chinese students.

The following research questions were posited in this study:

1. Is there any difference between American and Chinese students' attitudes toward computers?
2. Is there any difference between American and Chinese students' attitudes toward using computers when attitude is broken down into the four the aspects we are defining as variables: enjoyment, motivation, importance, and freedom from anxiety?
3. What relationship exists among the four aspects of computer attitudes with respect to American and Chinese students' computer achievement?
4. Which of the four aspects of attitude most influence the computer achievement of American and Chinese students?

Based on the findings of previous research, it was hypothesized that questions one and two would be answered in the affirmative—differences would be found. It was further hypothesized that a linear relationship would be found among the four aspects of attitude when question three was investigated. Finally, it was hypothesized that a definitive answer to question four would be provided (i.e., at least one of the four aspects of attitude would have a significant influence on computer achievement).

Method

Subjects

The American subjects in this study were 208 teacher education students enrolled in the College of Education at the University of Nevada, Reno. These students ranged in age from 18 to 53 (the average age was 24.29). Of these students, 138 were female and 70 were male. The Chinese

subjects included in this study were 210 teacher education students in a middle China teacher education college. They ranged in age from 20 to 33 (the average age was 23.58). Of these students 112 were female and 98 were male. Most of the American students and all of the Chinese students had no computer experiences.

Instrument

The instrument used in this study was derived from Aiken's (1979) Likert-type questionnaire consisting of 24 statements designed to measure the four attitude variables described above. The instrument has been shown to be a valid way to measure each of the four variables independently (Aiken, 1979).

Final scores in a basic computer technology course comprised the measure of computer achievement for both American and Chinese students. The American and Chinese courses covered the same basic topics. The topics covered in the two courses included: Windows95, word processing, telecommunications, multimedia, hypermedia, World Wide Web, spreadsheets, and databases.

Data Analyses

A repeated measurement procedure was employed to examine the difference between American and Chinese students' attitudes toward computers as reflected by four variables: enjoyment, motivation, importance, and freedom from anxiety. These four variables represented levels in the data analyses. Multiple regression analyses were conducted to test the relationships between computer attitude and computer achievement for both American and Chinese students. For both the repeated measurement and multiple regression analyses, the assumptions were checked and no significant violation of the assumptions was found.

Results

Repeated Measurement

The repeated measurement compared the attitude scores of the two groups of students—American and Chinese (referred to as TYPE in Table 1)—on the four variables considered levels in this analysis (referred to as ATTI in Table 1). Based on Aiken's information criterion, the CS (compound symmetry) was the appropriate type for this analysis. So, the Fixed Effects table was used (Table 1).

Table 1.
Tests of Fixed Effects

Source	NDF	DDF	Type I F	Pr > F
TYPE	1	416	0.39	0.5343
ATTI	3	1248	167.55	0.0001
TYPE*ATTI	3	1248	15.58	0.0001

The interaction effect is significant ($F = 15.58, P > 0.0001$). Results show that the mean score of American students and the mean score of Chinese students at the enjoyment level is different from that at the importance level. The mean score of American students and the mean score of Chinese students at the freedom from anxiety level is different from that at the importance level. The mean score of American students and the mean score of Chinese students at the motivation level is different from that at the importance level.

These results also show that significant differences were found between American students and Chinese students at the levels of enjoyment ($T = 2.84, p > 0.0046$), freedom from anxiety ($T = -2.26, p > 0.0237$), and motivation ($T = -3.06, p > 0.0023$); and no significant differences were found between American and Chinese students at the importance level ($T = 0.48, p > 0.6298$). The positive T value (2.84) indicates that American students had higher mean response scores at the enjoyment level than Chinese students. And the two negative T values (-2.26 and -3.06) indicate that Chinese students had higher mean response scores at the freedom from anxiety level and motivation level than American students.

Multiple Regression Analysis I: American Students

In this multiple regression analysis, enjoyment (X1), motivation (X2), importance (X3), and freedom from anxiety (X4) served as the predictor variables, and the response variable was computer achievement. The data collected from American students were analysed to detect the relationships between the four computer attitude variables and computer achievement, and to examine whether the attitude variables can be used to predict computer achievement. The multiple regression analysis shows:

1. The overall model is significant ($F = 162.446, p < 0.0001$), indicating that at least one of the four predictor variables has a linear relationship with, or has an effect on, the response variable. The R-square value is 0.7756, indicating that approximately 77% of the variation in computer achievement can be accounted for by the variation in the four attitude variables.
2. The F ratio for the linear trend is significant ($F = 159.2, p < 0.0001$), indicating that all the linear terms (X1, X2, X3, X4) should be included in this model. The quadratic trend and crossproduct are not significant; therefore, there was no need to test other quadratic and crossproduct terms.
3. The t statistics for the four variables are: X1 ($t = 5.548, p < 0.0001$), X2 ($t = 4.110, p < 0.0001$), X3 ($t = 2.033, p < 0.0434$), X4 ($t = 1.601, p < 0.0001$). All four of the t statistics are significant, indicating that all four variables have linear relationships with, or have effects on, the response variable. In other words, each predictor variable has an effect on computer achievement in the presence of the other three variables.

4. The F ratios testing the contribution of each variable are: X1 ($F = 6.116, p < 0.0001$), X2 ($F = 3.846, p < 0.0025$), X3 ($F = 1.453, p < 0.2074$), and X4 ($F = 27.026, p < 0.00001$). The X1, X2, and X4 contribute significantly to the variation of computer achievement. The order of the contribution of the four variables is—from the most important to the least important—X4 (freedom from anxiety), X1 (enjoyment), X2 (motivation), and X3 (importance).
5. The resulting regression equation is:
   Y = 27.9589 + 0.7879(X1) + 0.5557(X2) + 0.2334(X3) + 0.9843(X4)

Multiple Regression Analysis II: Chinese Students

This multiple regression analysis examined the relationships between Chinese students' computer attitudes and their computer achievement. Enjoyment (X1), motivation (X2), importance (X3), and freedom from anxiety (X4) again served as the predictor variables, and the response variable was computer achievement. The analysis shows:

1. The overall model is significant $F = 198.961, p < 0.0001$), indicating that at least one of the four predictor variables has a linear relationship with , or has effect on, the response variable. The R-square value is 0.7981.
2. The F ratios for the quadratic trend and crossproduct are significant ($F = 19.279$, and 5.356 respectively$p < 0.0001$). The quadratic term X2 and the crossproduct termed X1X2, X2X3, and X3X4 were shown to be significant at the 0.05 level. And, these four terms will be included in the model with the four linear terms X1, X2, X3, X4.
3. The F ratios testing the contribution of each variable are: X1 ($F = 14.440, p < 0.0001$), X2 ($F = 12.634, p < 0.0001$), X3 ($F = 6.876, p < 0.0001$), X4 ($F = 13.677, p < 0.00001$). The X1, X2, X3, and X4 variables all contribute significantly to the variation of computer achievement. The order of the contribution of the four variables is— from the most important to the less important— X1 (enjoyment), X4 (freedom from anxiety), X2 (motivation), and X3 (importance).
4. The resulting regression equation is:
   Y = 25.6937 + 6.6949(X1) + 7.2177(X2) + 3.3038(X3) + 2.2062(X4) - 0.2435(X1X2) - 0.2600(X2X3) + 0.1426(X3X4) + 0.1113(X2sq)

Conclusions

The research hypotheses set forth in this study were validated. American students and Chinese students differ in their attitudes toward using computers in terms of the degree to which they enjoy using computers, feel free from computer anxiety, and feel motivated to learn about and use computers. American students had a more positive attitude toward computers than Chinese students when the degree to which they enjoyed using them was assessed. However, Chinese students were more positive than American students about the degree to which they felt motivated and the degree to which they felt free from computer anxiety. There was no difference between American and Chinese students in terms of the degree to which they felt learning to use computers was important.

For both American and Chinese students, the four attitude variables—enjoyment, motivation, importance, and freedom from anxiety—can be considered variables in predicting computer achievement. Consistent with previous research findings, motivation and freedom from anxiety were found to have at least a linear relationship with computer achievement, and a positive effect on computer achievement. This study demonstrates enjoyment and importance also have linear relationships with computer achievement. Among the attitude variables explored in this study, freedom from anxiety and enjoyment were found more important than the other three. When a person is highly motivated to learn to use a computer, does not feel anxious about using the computer, or is aware of the importance of learning to use the computer, it is evident from this study that the chances are increased that that person will benefit from computer instruction and learn to use the computer well. The connection between enjoyment and achievement, as shown in this study, is of high interest since it suggests the enjoyment of using a computer will affect achievement even more than motivation and sense of importance. Previous studies on computer attitude rarely treated enjoyment as a variable, or quantified its influence on computer achievement. This finding has important ramifications for those who design and implement computer training programs. It is perhaps not an oversimplification to say that, when it comes to learning to use computers, students will learn best when they enjoy their learning experience.

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DTCs: Change Agents in Kentucky's Age of Technology

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When the Kentucky educational system was declared unconstitutional in 1989, the state Supreme Court mandated revisions to the entire system of public instruction. The resultant reforms included major changes in curriculum (including assessment and accountability), governance, and finance. To address the technology initiatives, the position of District Technology Coordinator (DTC) was created in each of the 176 school districts. Because of the rapid development of the position and the varying needs of individual districts, there are no certification requirements or specific guidelines for the selection or retention of coordinators. Similarly, districts were not provided specific guidelines regarding job responsibilities, performance criteria or assessment measures.

As educational technology becomes more complex, the qualifications to be a successful technology coordinator are beginning to generate discussion. Moursund (1992) asserts that the technology coordinator holds a leadership position and as such deals with three major components for instructional use of computers: learning and teaching about computers; integrating computers as a tool; and using the computer as an instructional medium. Additionally, a major role of the technology coordinator is to facilitate appropriate uses of technology through the design and implementation of staff development (Moursund, 1992).

Methods

This exploratory study used a mixed-methodology design to examine the various roles and responsibilities of Kentucky district technology coordinators. A researcher-developed survey and personal interviews provided data on various responsibilities and DTC perceptions.

All district technology coordinators (DTCs) from Kentucky (n=192) were targeted for the first two parts of this three-fold study and were mailed a research packet. While there are only 176 school districts in the state, the list generated by the state Department of Education named two persons as DTC in thirteen instances and included two state schools. Thus 192 names were listed for 176 districts.

Volunteers for the interviewing phase were selected based on schedule availability. A total of sixteen DTCs completed the entire interviewing phase of the study.

Data Collection Procedures

Each survey packet included a standard cover letter explaining the purpose of the study and the importance of his/her participation; the researcher-developed questionnaire; a self-addressed, stamped return envelope for the completed questionnaire; a self-addressed, stamped postcard for participants to indicate interest in volunteering for the interview phase; and a page of common symbols as a thank you for completing the survey. An initial and one follow up mailing resulted in 112 representing 58.3% return rate. District participation was at 68% (111 of 176 school districts responded).

Interviewees participated in individual, one-hour sessions either face-to-face, by telephone or through electronic mail. Five face-to-face interviews were held with DTCs in March 1997. All telephone interviews were held in late March or early April 1997. E-mail communications were on-going throughout the months of March and April 1997, as participants would respond to 1 or 2 questions at a time. The interviewer clarified points before sending the next question. Seven DTCs began the e-mail interviews and five completed all questions. Reasons for not finishing related to other job duties. For instance, during the interview phase, one DTC had to divert attention to the state assessment process.

Data Analysis

Quantitative and qualitative data were gathered simultaneously and analyzed both inductively and deductively. For instance, frequencies, percentages and correlation attributes were obtained from quantifiable survey and interview responses. Qualitative data were analyzed for themes and patterns that were used to clarify descriptive information from the survey and provide a richer explanation of the DTCs' perceptions regarding their position.

Quantitative data were subjected to descriptive statistics and the Pearson Product-Moment correlation

techniques. Frequencies and percentages were generated to describe related demographic data obtained through closed-ended items. A measure of the relationship between the demographic information and answers to survey items related to change were also analyzed to determine if any statistical relationships exist. Open-ended responses were grouped according to consistency of responses and used to support emerging themes.

Findings

Of responding DTCs, 66% were male and 30% were female. Most respondents, 73%, reported working in a rural school setting, as compared to 23% in urban settings. The average number of students in the school districts was 3398, with a median of 2100 and a mode of 2500 students.

Approximately one third of respondents hold a masters degree (31%) and another third have completed at least 30 hours beyond the masters. Of the respondents, 22% have taught one of more college classes, and approximately 56% have experience teaching in middle school, high school, or both.

The average number of years of teaching was almost 16. Nearly 13% have no teaching experience, or even teacher certification. Nearly half of all respondents had previous administrative experience. The average term of service as DTC was 4 years, and most have worked with instructional technology for an average of 8 years. Still, only 7% of respondents hold Novell certification.

Two of the most frequently identified professional development needs relate to the use of technology in the schools (64%) and a need to learn more techniques for training school personnel (61%). Likewise, 57% of respondents expressed a need for training in the selection of appropriate academic software, and nearly one-half indicated a need to receive more training in the maintenance of hardware. The uses of assistive technology, learning more techniques for evaluation and assessment and learning how to plan collaboratively were also frequently requested professional development needs.

Most DTCs are solely responsibility for completing the district technology plan, overseeing the budget, and make purchases. Most DTCs report being solely responsible for the technology spending, purchase orders, tracking, inventory control and planning for future expenses. When asked to specify the most important or critical decisions they were responsible for making, responses clustered in the planning stages. Purchasing equipment and spending money wisely for future needs were the most commonly mentioned critical decisions. Interestingly, there was a positive correlation among respondents holding Novell certification and high ratings given in the areas of purchasing equipment (significant level .0117) and planning for future expenditures (significant level .0253).

Consultation and problem-solving with teachers and administrators was typically rated as very important. Troubleshooting hardware and software problems also received particularly high ratings, with a mean of 3.5, a median and mode of 4, on a 1-4 scale. Gathering and assessing information was viewed as very important, but communicating information to administrators, conferences with teachers, completing state reports and systematic assessment were viewed as only somewhat important. According to DTCs, there appears to be no standard means for measuring and evaluating computer progress within school districts.

DTCs are eliciting change through training activities, which occupies an average of 17 hours per month. Among the activities rated as very important or absolutely essential include communications with staff and workshop offerings. Observing the use of technology in the classrooms, clarifying misconceptions and training cadre groups were viewed as somewhat important or very important. All interview participants devoted at least two days per year providing technology in-service workshops. Several DTCs referred to previous years in which up to 21 days of training was provided in an effort to prepare the staff for the new technologies. Many DTCs indicated shift in their training methods to more one-on-one and small group sessions, often conducted in the classroom setting. There was an inverse relationship between Novell certified individuals and significance attributed to conducting workshops with school staff (significance level .0281) and modeling uses of technology to school staff (significance level .0128).

Several DTCs stressed the importance of keeping their Boards of Education informed of the technology needs and progress, since many districts are exceeding state financial allotments to provide more technology to the schools. However, communication with parent groups and presenting at conferences were viewed as only somewhat important.

Insufficient time was the greatest obstacle encountered by 70% of the respondents The most time consuming activities were technical responsibilities, financial planning and administrative tasks. Additional job responsibilities tended to interfere with completing maintenance activities in a timely fashion.

Several districts have additional, designated staff to provide technical support. However, 34% of respondents indicated that additional technical support was needed. There were no identifiable patterns found based on size of district, gender, classified or certified position among districts that currently have additional support personnel.

Most DTCs were involved in some type of professional group such as the Kentucky Association of Technology Coordinators (KATC). Overwhelmingly DTCs attribute their success to the services of the KETS (Kentucky Education Technology System) engineers (60%) and KETS regional coordinators (37%).

When asked to specify the most important qualifications of a DTC respondents identified three: educational background, technical background, and good people skills. There was nearly a total consensus for higher education to provide additional technical training. The exceptions to listing technical training came from classified personnel, who listed "hands on" experiences as necessary for higher education to consider in their programming. Additionally, DTCs express the need for higher education to improve the training of teachers and administrators in the use and integration of technology into the curriculum.

Summary and Implications

As educational technology becomes more complex, schools are creating leadership positions to assist in its implementation. However, the position of technology coordinator evolved at such a rapid pace, the selection of appropriate individuals and support needed to ensure success, has been difficult and resulted in inconsistencies in services.

The persons presently serving as DTCs in Kentucky expressed frustration with the lack of time to perform duties, as well as the need for higher education agencies to provide more for teachers and principals in the use of technology. Similarly, the most frequently identified professional development activities relate to school-based concerns. Specifically DTCs expressed a need for greated education regarding the use of technology in schools, a desire to learn more techniques for training school personnel, and a training in the selection of appropriate academic software. Similarly, the inconsistencies in responses related to consultation activities indicated a need for greater clarity in expectations for the integration of technology into the curriculum.

Kentucky has made an attempt to create equity through the use of systemic reform. The success of the reform is dependent on implementation in every Kentucky school district. While it is not clear how this will best be achieved, Kentucky has made an attempt to provide supports to schools. Leading the way in the implementation of technology upon school districts are district technology coordinators. This study offers baseline demographic and descriptive data which may assist those responsible for developing evaluation procedures, certification requirements and developing professional development activities. Furthermore, clarity in job duties, responsibilities and expectations offer a greater chance of success to schools.

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A Statewide Evaluation of the Impact of Technology Integration

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Over the past four years schools and districts in Idaho have received $41.2 million in state funds from the Idaho Legislature for the integration of technology into the curriculum. This is an average expenditure of $168 per student over the past four years. During the fall of 1997, research was gathered from a cross section of Idaho's school district and teachers. From this research, it is graphically apparent that Idaho has reached the point of "critical mass" for full-scale integration of technology into the curriculum. Teachers have taken the initiative of expanding one or two ideas into a plethora of ways to use technology in their classrooms and curriculum to challenge their students. Because of this increased interest, many teachers are using personal funds to purchase software for their classes. They are "scrambling" for access to any technology including "old" equipment. Three or four computer generations are found in classrooms – teachers are repurposing outdated technology to fit a particular need. Schools with computer labs are finding that they are completely booked throughout the school day and many classes wishing to use it find access impossible. Based on the data gathered as part of this report, teachers and administrators are reporting the following as the greatest benefits derived from this funding

- School libraries are enhancing and greatly expanding their collections by providing increased access to current research via the Internet.
- Teachers are involving students in research which benefits not only the student but also the community. Students are conducting active research and presenting that research to local school boards, corporations, international and national conferences, and other community groups who are listening to them as they would to experts.
- Teachers are using "drill and practice" software to strengthen basic skills, enabling students to better understand the transition to more complex concepts.
- Teachers are using programs such as Accelerated Reader to build student's reading skills, to provide students with optimal challenges in their reading choices, and to assess reading ability.
- Districts are building a larger educational community by giving students and teachers access to the Internet and e-mail.

This article details and synthesizes the data used to derive these benefits and other impacts that the integration of technology is having on Idaho's teachers and students. The methodologies used for data collection are described, and results detailed, in the following sections.

Methodology

Eight questions formed the focus of this study:

- How have districts used the technology funds allocated to them by the state?
- What technology hardware and software have the districts purchased?
- What training have teachers received relevant to the integration of technology into the curriculum?
- What technology related skills have teachers acquired?
- How are teachers using technology within the classroom?
- What technology related skills have students acquired?
- How have students used the technology skills acquired to problem solve, do school work, and address real-life situations?
- What impact has the integration of technology had on student performance?

Data have been collected to answer these questions from a variety of sources including, but not limited to: the annual application for state technology funds submitted by districts, district budget reports to the Idaho Financial

Accounting Report Management Systems (IFARMS), university reports to the State Board of Education, interviews with K-12 educators, classroom observation, and surveys. The state and university reports were used to answer the first three questions listed above. To investigate the remaining five questions, a sample of just over half of the districts in the state were selected, from those districts one or more schools were also randomly selected to participate. Five to ten teachers were randomly selected from each school and asked to participate in a Level of Use Interview, as well as to complete a survey regarding the impacts of technology integration; only five of the teachers selected at each site were interviewed and surveyed. In total, 80 schools from 67 districts participated in the evaluation and 378 teachers were interviewed, 98% (372) of those teachers completed an Impact of Technology Integration Survey (here after referred to as the impact survey.) The results of that study as well as the results gleaned from the districts Technology Grant Application and Progress Reports for 1996-1997 are presented in this report.

The Level of Use Interview is one element of the Concerns-Based Adoption Model (CBAM), a model that was developed, in the 1970s to assess, facilitate, and evaluate change. The Level of Use interview has a 98% correlation with observation (Hall & Hord, 1987). The CBAM model provides a strong tool for evaluating implementation efficiently and effectively. Department of Defense schools, industry, and other state agencies are actively using CBAM to evaluate and facilitate the change process. From university reports we can determine the number of teachers who have been trained; CBAM allows us to assess the degree to which teachers have implemented this training. The impact survey which was administered contained questions regarding the impact of technology integration into the curriculum. The statements to which teachers were asked to respond addressed the quality of student work, learning behaviors, teaching with technology, communication with parents and students, interactive classroom organization, student technology skills, and student-interaction. The purpose of the survey was to assess teacher perception of the impact technology is having on student learning, development of technology skills, achievement, and on the teacher's teaching pedagogy. The procedures followed in this study allows us to create a profile which reveals the degree to which technology is being used to instruct the students of Idaho and what impact that it is having on their learning.

Population

This report relies upon multiple points for the collection of data: the Technology Grant Application and Progress Report for state technology funds, university reports to the State Board of Education, Level of Use Interviews, and an impact survey completed by a stratified random sample of teachers. Most of the schools (572/672) and 111 out of 112 districts within the state provided information included in this report when completing their Technology Grant Application and Progress Report for 1996-1997. Included in this application were a written inventory survey, a standards checklist, responses to goal congruence, and a budget report. A stratified random sampling procedure was used to select participants in a more detailed study, described above, which focused more directly on the impact that technology integration is having on teachers and students.

As stated previously, participants in the impact study were selected from more than half of the districts in the state; at least half of the districts in each region were included in the study. The participants selected from the districts ranged in age from 23 years to 63 years with the greater part of the sample, 38% (142), being between the ages of 46 and 55; 66% (246) of the sample were female and 34% (125) male, and were largely Caucasian in ethnicity (99% or 368). The number of years teaching ranged from first year teachers to those with 38 years experience. The sample was split more or less evenly between secondary (47% or 175) and elementary (53% or 197) teachers. Secondary teachers were drawn primarily from the core content areas: math (21% or 36), science (27% or 47), English (30% or 52), and social studies (21% or 36). Sixty-eight percent (254) of the teachers held a bachelor's degree, 26% (96) master's degrees, and just over one percent (5) have acquired a doctorate or specialist degree.

Results

During the 96-97 school year, districts again expended the majority of their state technology funds for capital objects, including computer hardware, software, networking equipment, telecommunications equipment and other audio-visual related items. Primary among these expenditures was computer hardware. Their expenditure of "in-kind" funds totals $17.2 million. The expenditure of these funds mirrors those made with state-technology dollars. Again, the majority of funds have been used to support the purchase of capital objects in the form of computer hardware. Districts are gaining better access to technology for their students and teachers.

The ratio of students to computers has gradually improved over the last three years. Within the past year, Idaho has finally achieved a 5:1 student to computer ratio, however only 58% of these computers are multimedia ready. When comparing the ratio of students to multimedia ready computers, the ratio is 9:1.

Connectivity has also improved; districts are becoming increasingly connected, both within the districts as well as the outside world through the Internet. Over 76% (435) of

the schools report having a Local Area Network (LAN), averaging two LANs per district. An increasing number of schools, 59% (340), report that their district has developed a Wide Area Network (WAN) to connect buildings to the district office. The majority of the schools reported that they have access to the Internet (84% or 479). To obtain access to the Internet, 51% (292) of the schools reported having a direct link, while 31% (128) reported relying on dial-up services.

An increasing number of teachers are becoming technologically literate through training offered by the universities, district inservice and professional development programs, and informal training opportunities available in their schools. In the district technology applications, 72% (408) of the schools reported that their districts included professional development days as part of their school calendar. Schools reported a varying amount of in-house training ranging from 0 hours to over 500 hours of instruction per school year.

The configuration used by the teacher to integrate technology within the curriculum as well as the teacher's level of use determined, to a great extent, the teacher's perceptions as to the types and degree of impact that technology was having on their students and on their teaching. The degree of access that teachers have to technology also influenced the teacher's view of the impact that technology is having on their students and their teaching. Access also influenced the teacher's level of use and the primary configuration they used for integrating technology into the curriculum. Those who had a lab available to them were more likely to report that technology was having a positive impact on their students and on their teaching. They were less likely, however, to report that students were developing technology skills such as those associated with word processing, spreadsheets, databases, presentation packages, or authoring systems.

In the following paragraphs, each area of impact will be directly discussed: learning behaviors, quality of student work, interactive learning, teaching with technology, student technology skills, student-interaction, and communication with parents and students. The influence of the teacher's level of use and the configuration that they were using to integrate technology into the curriculum will also be addressed.

Learning Behaviors

The statements posed in the survey, regarding the learning behaviors exhibited by students, focused on the skills related to self-regulated learning and other behaviors associated with being a "self-starter." In most cases, 50% or more of the teachers "agreed" or "strongly agreed" that technology was a positive influence. Teachers who were identified as refining their use of technology in order to have a greater impact on their student's learning were more likely to respond positively to these questions, as were those using a generative or drill and practice model for integrating technology within the curriculum. Those using the computer primarily as a resource tool tended to respond negatively to these questions, expressing the belief that technology was not impacting their student's learning behaviors.

Quality of Student Work

Statements regarding the quality of student work focused on the actual quality of assignments being completed for the class. The object in asking these questions was to determine whether or not technology was having a positive effect on the attention students paid to their written work. Again, responses were largely positive, with more than 40% of the respondents agreeing or strongly agreeing with the statements posed. Those teachers using a generative model for integrating technology within the curriculum were more likely to agree or strongly agree with the statements.

Interactive Learning

The statements regarding concepts related to interactive learning focus on those instructional processes that directly involve the student with the learning process. The focus of instruction is placed on the student and increasing the student's role in the learning process. In most cases, more than 50% of the respondents agreed or strongly agreed with the statement. An interaction between level of use and configuration seemed to have some effect on the responses given to these statements, however no particular group was more likely to respond positively or negatively to the statements.

Teaching with Technology

A clear majority, 63%, or 235 of the respondents, declared positively that the computer has become a learning tool in their classroom. In response to these statements relative to teaching with technology, teachers created a picture about their use and comfort in using technology. Statements centered around using technology to design improved opportunities for learning and authentic assessment, increased enthusiasm for teaching, sharing ideas for integrating technology with colleagues, using a greater variety of teaching strategies, making content more relevant to students, and greater access to outside resources. Again responses were largely positive. In most cases, more than 75% of the respondents agreed or strongly agreed with the statement.

Those refining their use of technology or collaborating with other teachers to increase the impact of technology on their students were more likely to respond positively to questions regarding the use of technology to facilitate teaching and learning. Interestingly, those who had achieved a "routine" level of use and were no longer expanding their use of technology did not respond as

positively to these statements. They seem to have achieved a plateau in their use of technology and did not perceive the need to increase their ability and knowledge to use technology effectively with their students.

Student Technology Skills

Students are gaining skills with the word processor, database, spreadsheet, authoring systems, and presentation programs. Configuration and level of use had a strong effect on the teacher's perception of the development of student technology skills. Those teachers using a generative model for integrating technology within the curriculum and teachers refining their use of technology were more likely to respond positively to these statements. Teachers at a mechanical level of use or using a drill and practice or resource model for integrating technology were more likely to respond negatively. The development of technology skills seems to be strongly tied to being given the opportunity to work with these application programs. A generative model typically emphasizes the use of application software.

Student Interaction

The statements included in this category focused more on using the student as a resource in the classroom. By giving students opportunities to teach other students and to work collaboratively with other students, teachers are giving students an opportunity to assume the role of the teacher. It is understood that when a student has to explain a concept or procedure to their peers, they tend to gain a greater understanding of that concept or procedure. Statements referenced peer tutoring, facilitating student to student interaction, and using students as a resource for working with the computer. More than 50% of the responses to these statements were positive. Teachers using technology primarily as a resource were more likely to respond negatively to these questions. Those using a generative or drill and practice model for integration into the curriculum were more likely to respond positively.

Communication with Parents and Students

Those statements that refer to communication issues include references to using electronic media to communicate with students and parents, keeping grades electronically, and communicating with parents more frequently. The purpose for including these statements was to determine if technology allowed teachers to communicate more frequently with parents and students. A smaller percentage of the responses were positive for this factor, however, more than 30% indicated positive response. This could be an indication that our communication tools (e.g., e-mail) are less extensive than other technologies

Those teachers refining their technology skills were more likely to respond positively to these statements. Those using a drill and practice model for integrating technology within the curriculum and those using technology as a resource, however, were more likely to respond negatively. Teachers who are expanding their use of technology and using a generative model for integrating technology seemed to be more open to the possibility of using it as a tool for communication.

The teacher's level of use and configuration had strong effects on their perceived impacts of technology and, therefore, probably an effect on the actual impact technology is having on student performance and the teacher's teaching style. Those achieving greater levels of impact were those teachers still striving to refine their use of technology. Their focus in refining their knowledge and skills is having a greater impact on student learning and achievement. Those with this focus, whether working individually or collaboratively, are achieving greater success with their students and on their teaching. Their students are submitting higher quality work, exhibiting self-regulated learning strategies, and developing technology-related skills. These teachers also see themselves as using technology as a teaching tool, increasing student interaction and interactive learning, and facilitating communication with parents and students. These impacts are increased when the teacher is also following a generative model for integrating technology with the curriculum. The study shows that students using technology as a tool for learning are receiving greater benefits.

Summary

The Idaho legislature has created conditions in Idaho schools that verge on a burst of expansion. From what this researcher has seen the last few months, Idaho has reached critical mass for full-scale integration of technology within the curriculum. Teachers have been provided just enough technology and information to start; they have replicated this knowledge into more ideas for effectively using and integrating technology into their curriculum.

The computer is an adaptable and versatile tool, in essence, an educational Swiss Army knife. While it is an important tool, it is but one of many tools. When used appropriately technology can be a very effective tool. Some of the effects that the integration of technology is having on Idaho's students and teachers have been described in this report. Of primary importance are the following impacts, which were reported by the teachers interviewed:

- Technology is helping to foster positive learning behaviors and self-regulated learning strategies in students
- The quality of student work is improving through the integration of technology by teachers.
- Interactive learning is being fostered in classrooms where technology is being integrated.
- Teachers reported using technology as a teaching and planning tool.

- Students are developing technology skills associated with application software such as word processing, spreadsheet, database, or presentation programs.
- Interaction between students and collaborative learning is being fostered in classrooms where technology is being integrated.
- For many schools, technology has expanded the amount and range of resources available to them. Technology has enhanced many school libraries to a great extent.
- E-mail is being used to facilitate communication between educators, parents, and students. Expanded electronic communities are beginning to grow.

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Authentic Assessment of Computer Competencies: The Technology Competency Profiler (TCP)

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The report, "Technology and the New Professional: Preparing for the 21st Century Classroom", recommends the integration of technology into teacher education programs. These recommendations should also apply to in service teacher staff development programs. This report describes the technology skills and knowledge that must be acquired by the new breed of professional teachers to be competent and effective users of educational technology.

Today, teachers need to understand the impact that technology is having on the world of work, communication, and the acquisition of new knowledge. Teachers must realize and recognize that information can be accessed through a variety of media resources. Technology can help find, organize, and evaluate this information. Information can be compared and reviewed critically using a number of technology-based resources. A new breed of technology competent professionals have the power to change the world of teaching and learning. Technology, like the printing press, has the power to change the way students see and understand our world - our universe. Its users must be competent to harness that power and create effective learning environments.

Technology Competencies

A growing number of states and institutions have adopted standards or competencies relating to professional educators and their ability to know and utilize technology in the teaching and learning processes. In order to meet these standards, teachers must provide evidence that they can use computer technology for solving problems, collecting data, managing information, communicating with the outside world, creating effective presentations, and making informed decisions. They should be competent in creating, preparing, and producing visual instructional materials that support the current curriculum at their grade level or within their subject area. Some organizations require a real-time demonstration of these skills, however, this would be very time consuming for administrators or instructional technology specialists to enforce. To meet this need for evaluating the technological competency of educators, the Technology Competency Profiler (TCP) was developed. This self assessment tool provides the individual with a quantitative evaluation of their knowledge of technology and the necessary skills to apply them in their classroom environments. The Technology Competency Profiler (TCP) is updated every three years to incorporate new concepts and skills.

The Technology Competency Profiler (TCP) is an authentic assessment of technology competencies that must be either documented or demonstrated by preservice or in-service teachers. These competencies are embedded in a 100 statement questionnaire ranging from basic skills and knowledge to a sophisticated use of multimedia in a classroom presentation. Each statement must be true for all criteria to be considered acquired. The following statements are examples taken from the TCP.

Technology Competency Profiler(TCP)

- In a computer Operating System, (i.e. MSDOS, Windows, Mac OS), I can change the system prompt or desktop configuration.(E)
- In a spreadsheet application, I can paste, edit, and move spreadsheet files into a word processing document.(E)
- Using an appropriate software application, i.e. Power point, MacPaint, Super paint, I can design templates, color schemes, and graphs to produce a professional presentation.(I)
- Using the Internet, I can create, maintain, and delete bookmark entries, perform searches, receive files from remote locations, enter new URL's.(I)
- Using an appropriate software application, I can create, save and edit a Home Page on the Internet.(I)
- Using current software, I can produce a plan to integrate tutorials, simulations, and problem-solving programs into a course of study. (I)
- From available resources, I can prepare a report that describes at least two(2) successful projects associated with staff development and teacher education to ensure continual teacher computer competency in the classroom.(A)
- I can plan and produce a multimedia presentation.(I)

- I can use and evaluate a distance learning system that includes computer, audio and video conferencing.(A)
- I can list at least three strategies using educational technology in a variety of authentic educational settings.(A)

(E) ENTRY——(I) INTERMEDIATE——(A) ADVANCED

Assessing Competency Levels

A scoring sheet for all of the statements allows preservice and in service teachers to evaluate their level of technology skills and knowledge. In addition, recommendations are provided for those individuals scoring below the satisfactory level in the three performance groups.

On the questionnaire's scoring sheet a one (1) is placed next to each Yes response to the statements containing the technology competencies. There are three columns of statement numbers associated with each level: Entry, Intermediate, and Advanced. Add up the ones (1) in each of the columns and compare the scores at each level with the following evaluation and recommendations.

For each category, 0-15 points is Unsatisfactory; 16-20 points is Below Average; 21-29 points is Average. For the Entry-level category, 30-33 points is Good. For the Intermediate-level category, 30-32 points is Good. For the Advanced-level category, 30-35 points is Good.

Summary

A review of the different levels and degrees of competencies found on the evaluation sheet related to the knowledge and skills in educational technology would provide the guidance for immediate or future staff development projects or course work in this field. A score below 21 points at the Entry-level might suggest some missing basic components, and a self study of reference books or basic undergraduate or graduate course work might help fill in the missing competencies at this level. A score below 21 points at the Intermediate-level indicates that more advance applications of technology have not been mastered, and if they are to be incorporated into a teaching portfolio, then updating technology course work is strongly suggested. A score below 21 points in the Advanced-level might suggest a need to review current applications of technology in education, and this could be accomplished through graduate course work or professional seminars.

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LAPTOP SUCCESS AND HORROR STORIES

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Laptops are becoming more and more popular in our everyday life. In some schools, colleges, and universities such as The University of Minnesota, Crookston (alias ThinkPad University), Waldorf College in Forest City, Iowa, Valley City State University in North Dakota, Acadia University in Wolfille, Nova Scotia, Georgia Clayton State College and University and Floyd College in Rome, Georgia, Ursuline Academy of Dallas, ACT Academy in McKinney, Texas, a laptop-for-every-student policy has been in place.

Results of a 1996 pilot study of the 52 schools that participated in a Microsoft and Toshiba laptop initiative called Anytime Anywhere Learning (Microsoft Corporation, 1997) indicate that laptops have a powerful impact on how teachers teach and what students accomplish. In our study of schools, colleges, and universities, we wanted to find out the answers to the following questions about laptops:

- State University of West GeorgiaHow are students and teachers using laptops?
- State University of West GeorgiaHow do these schools, colleges, and universities fund their laptops?
- State University of West GeorgiaWhat are some horror stories connected with laptop use?
- What are some success stories connected with laptop use?
- If laptop loan service is available, what are some recommended policies related to laptop checkouts in libraries or lending centers?
- What kind of advice or tips can these laptop users provide the readers?

Data collection

We went through the listserv archives of EDTECH, LM_NET, and AECT found on the net and printed out all the comments and responses related to laptop that were made throughout a period of three years, from 1995-1997. There were 36 of these. We also wrote the listserv members in November 1997 and asked them to tell us how they are using their laptops and to share with us their success and horror stories. We received 15 responses from the listservs. Three respondents referred us to three web sites, namely, those of Anytime Anywhere Learning Microsoft/Toshiba project, University of Minnesota Crookston, and the Waldorf College. Part of our data came from these web sites. A few of the respondents were more interested in our findings rather than providing the answers. We also interviewed ten faculty members from various colleges and universities in the University System of Georgia.

Analysis

Content analysis was performed and the data we received was assigned to categories. Categories used were: educational applications, success stories, horror stories, funding, policies, advice/tips, participant verification (in progress), and laptop management policies (in progress).

Preliminary Results

Educational applications. Professors, librarians, and students are using laptops in many ways. A professor of Criminal Justice is using a laptop to write a textbook. The convenience of being able to work on the book at home as well as at the office was cited. Librarians in Georgia are using laptops to demonstrate the different databases in GALILEO or Georgia Library Learning On-Line, to take notes in off-campus meetings, and to keep in touch with the office.

Many professors are using their laptops to present their Microsoft PowerPoint lectures and other multimedia presentations and to access web resources and CD-ROM based materials. The University of Northern Iowa have two sets of laptops (Macintosh and Compaq) to use in their on and off campus staff development training workshops for K-12 schools. Portability, ease of use, and ease of set up were cited.

Students are using laptops to take notes during class, do the layout for school newspaper, access Internet resources, do multimedia authoring, do science experiments (attaching probes to laptops to collect real data in the field), write their papers, collaborate with peers, contact professors, and send electronic mail to prospective employers. School teachers are using laptops for their lesson plans, grade records, word processing, internet research, and e-mail.

Success stories

The success stories told by users in schools and higher education focused on the following outcomes:

- Students are learning from students and teachers are learning from students about technology
- Teachers are becoming more comfortable with technology
- Teachers are using more small-group, project-based and individualized instruction
- Students are developing communication skills
- Students are spending more time in creative and critical thinking
- Students are more motivated in learning
- Students are taking greater responsibility for their own learning
- Students are doing more collaborative learning
- With the sense of ownership, students are being urged to do extra work ìsimply because itís fun to use a computerî
- Students' way of learning are being expanded
- Students are becoming negotiators and discoverers of information
- Parents are becoming more interested and more involved with the education of their children

Horror stories

There were a few horror stories. One College of Education staff member from Houston, Texas told us that they purchased 20 Macintosh laptops for faculty and students with grant money. ìOne year later, we lost half of them, because it is so easy to walk off with a laptop. The rest were broken because people dropped them or were sloppy with their use. There was not a person to maintain them, charge the batteries, or kill the virus [sic],î she stated.

Another public school teacher revealed in the EDTECH listserv that ìthe dirty little secret about laptops is that they are expensive to buy, break easily, and are expensive to fix.î An English teacher said that her hard drive crashed just three months after she got it. It took five weeks for it to be shipped back to California and be replaced.

Other schools reported about laptops being destroyed due to one of the following reasons:

- The laptop was dropped on a cement porch
- The laptop was left in a hot car
- The laptop that was left in a car with an open window did not get stolen but got wet from the rain.
- The laptop was dropped from the desk onto the tile floor
- The laptop was dropped in the bus and kids stepped on it

A university professor told us her laptop did not want to cooperate with the DataShow projector but she admitted that it could be an operatorís error

Funding

One respondent said that there was no single way for a school district to finance and acquire computers. Financing options mentioned by various schools were: outright purchase, monthly rentals, three-year leases at a certain finance rate. Adopt-a-kid program for individuals, business and community groups, parental or relativesí support, community foundation, private and state grant funding were also sources of funds to help support the studentsí personal learning tools.

Universities that were involved in a laptop-for-every-student policy required the students to pay for their laptops as part of their tuition.

Advice/tips

The following advice and tips were offered by laptop users:

- Place the emphasis on the curriculum and not on the technology
- Put laptops in the hands of the teachers not just the students
- Provide teacher training
- Provide technical support staff to help with hardware or software problems
- Select laptops you can live with

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A NEED FOR TECHNOLOGY-BASED TEACHER RESEARCH

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Infusing technology in teaching and learning has become a national norm. Teachers are expected to have good computer skills and know how to integrate technology effectively in the curriculum. At present, most classrooms have some computers, and students are enthusiastic about using them. Computers seem to have provided great potentials to enrich the classroom teaching and to improve teachers' productivity. However, in real life, after advocating the computer technology for education for over two decades, very few schools have integrated it into their curriculum. In addition, most teachers do not feel comfortable about using it. In order to infuse computers in the curriculum, teachers should know not just how to use computers themselves, but also how to engage their students in active learning with computers. In other words, we need more technology-literate and enthusiastic teachers.

Secretary of Education Dick Riley (1997) predicts that this nation will face a severe shortage of teachers in the next decade if we do not focus our attention on recruiting quality teachers. We are already facing an immediate challenge--most teachers do not feel comfortable using technology or integrating computer technologies into their curriculum. Workers in business and industry have kept up with the new technology whereas educators are falling behind. New efforts are indispensable to engage teachers in using the existing technology and in making it actively functional for better education.

Technology in teacher preparation

One might think that an alternative to infuse technology in school education should come from higher education. The university teacher education programs should assume the leadership and take initiatives to provide public schools with insights. University teacher educators should also provide training and opportunities to help teachers catch up with educational computer technology. However, such a top-down approach where teacher educators provide school teachers with input and guidance, might not work without modifications. Various factors should be considered.

Currently, teachers need more than just training and guidance to integrate technology into education. Researchers such as Zehr (1997) indicate that school teachers do not feel comfortable or ready when teaching with new technology. The majority of teachers, do not possess sufficient technology resources, such as software and hardware to engage their students in meaningful technological activities.

An additional factor that discredited the university teacher educators' efforts is the gap between the university and public education. It has been widely discussed among teachers that the university professors have become ignorant of the classroom reality. Sengupta (1997) indicated that education professors are "out of sync" with public school teachers and the public on fundamental issues like what and how teachers should teach. In the application of educational technology, oftentimes, teachers criticize the university teacher educators for advocating goals which are difficult to implement or unattainable (Stephenson, 1997). Stephenson (1997) also found that significant differences exist in the expectations about students' performance in computer education between high school teachers and university instructors.

Most technology-based research is conducted in higher education. In many cases, teachers are included only as subjects, but not as researchers. As a result, regardless of what researchers suggest to improve the classroom teaching with technology, teachers are continuing what they are currently practicing. For example, many studies suggest that a well-planned technology implementation can enhance students' learning experience and increase their motivation, and teachers should work collaboratively to better such an effort. However, many schools are relying on the technology coordinators to conduct computer lab sessions without the classroom teachers' direct involvement. The computer coordinators, who may know how the computer operates, might know very little about what is being taught in the classroom. Some teachers even consider students computer time as break time. Such discrepancy should be reduced to the minimum before the research findings can have serious impact on the real practice in the school.

Issues and challenges

Requiring all teachers to possess needed technology literacy and to integrate technology into their curriculum,

though important, is a tough challenge. While many teachers agree to the importance of technology in education and express a desire to pursue the advancement of their skills, we are facing some big challenges: 1) how to make teachers realize the true potential that technology can provide, 2) how to convince them that it is worth their time and effort, and 3) how to lay out a systematic approach to actively involve all relevant personnel such as teachers, students, administrators, professors, and others to infuse technology in education. To meet these challenges, many obstacles as described below need to be overcome.

Teachers' computer skills are generally low.

Teachers' vision about educational technology is often hindered by the lack of technological skills. Presently most teachers possess very limited technological skills. They would have to spend plenty of time working on various technology projects before they master the skills. Not until they feel comfortable about using technology in their work, will they seriously become involved in implementing technology in curriculum.

Practical teaching experience is essential to successful implementation of technology in the class.

From the experience of teaching undergraduate preservice teachers to integrate technology in instruction, the author found that most preservice teachers normally do not perform well due to a lack of clear ideas about classroom scenarios, events, interaction, and procedures. To help them learn to integrate technology effectively, preservice teachers need to be exposed to concrete examples and practical teaching scenarios. Many practicing teachers can catch up with and apply what they have learned to the real classroom setting quickly. It is practical to connect the preservice with the practicing teachers to exchange their technological experience as well as the real teaching experience.

Many teachers feel outperformed by their students.

Students often seem more technologically interested and skilled than adults. Many teachers feel threatened by their students' technology skills. It is important to help teachers to overcome the anxiety and feel ready. Teachers may use skillful students as helpers or role models for the technology-enriched class activities.

Teachers are concerned about insufficient technological resources.

Although there are plenty of resources on the software market as well as on the Internet, most teachers find it difficult to locate good resources to meet the instructional needs. In fact, there are many ways to acquire valuable instructional resources, such as finding reviews from educational journals or magazines, consulting with experienced users, checking with the vendors, requesting and testing a sample programs from the vendors.

Acquiring technological resources does not necessarily guarantee the successful technology integration.

From the frequent contact with school teachers, the author ,on many occasions, witnessed good, expensive commercial software programs being misused in the classroom. However, he also witnessed some teachers developing innovative activities using plain shareware programs to motivate students to learn. It is fair to say that effective use of the resources for instructional purposes is more important than acquiring the resources. Nowadays, with easy access to the Internet, it is possible to locate and retrieve resources directly from the Internet. It takes thinking, organizing, and problem-solving skills to find the needed resources. Once teachers have mastered these skills, they can teach their students to locate information on the web, and even engage their students in higher-level thinking and problem-solving activities.

Technology-based teacher research: a proposed model

A model (as shown in Figure 1) derived from the author's experience of working with practicing teachers to develop technology-based research may have provided a possible solution to the current technology challenge in the school. These practicing teachers participated in a technology-enhanced instruction master degree program. The participant had diverse backgrounds and technology experiences. Some of were novice computer users and others were more experienced. Throughout a few semesters, they mastered basic computer skills, gained new insight about technology in education through exchanging ideas about how computers can be best used to support their teaching. They also conducted research on their own to find solutions to the perceived challenge of improving their teaching performance with new technology. At the end of the degree program, almost all of them became a master of technology in their own school. They continue to implement technology in their own classes and provided leadership to other people in the school.

Several key factors have contributed to the success of this model. They include 1) the reasonable nurturing experiences through which teachers mastered needed skills, 2) the integrative applications and research with which teachers tied what they have learned in the university to their own classrooms, 3) the collaboration between the university and public schools with which teacher educators broke the isolation, touched the school teachers, and helped them become enthusiastic about technology, 4) the self-awareness process through which teachers can identify problems in technology integration and find solutions themselves, and 5) role-shifting with which teachers have

moved from a passive role of being researched to a role of active researcher.

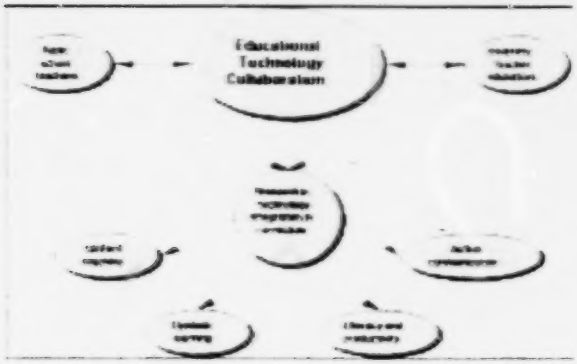

Figure 1. A technology-based teacher research model

Engaging teachers in active computer-based research is a means to help teachers to catch up with technology. Cochran-Smith and Lytle (1993) suggest that teachers should not just be passive followers, but function as architects of study and generators of knowledge. Such a radical shift from receivers to researchers transforms the notion of research on teaching and provides a radical challenge to assumptions about how teachers learn and about what constitutes a knowledge base for teaching. If they started conducting computer-based research in their own classroom, they would soon become sensitive to the real needs of technology and be anxious to become masters of the teaching environment and generators of the new knowledge.

Engaging teachers in active classroom technology-based research is a significant practice. Teachers should know about not only how to use technology but also how to integrate technology in their teaching practice and to engage their students in active learning and research. Shermis et al. (1991) point out the fact that the computer technology has impacted on the research process cannot be overestimated because microcomputers have touched virtually every aspect of the research process.

Earl and LeMahieu (1997) identified three major factors that may affect teachers' performance and lead to devastating consequences for educational change and reform include the following: 1) work in isolation, 2) are generally excluded from knowledge production, and 3) Are subjugated to external quality control. These factors can apply to the technology application in the school. Just as Earl and LeMahieu suggest, the collegial teacher research may improve the situation. Teachers collaborate and cooperate by sharing experience and information with each other and by working together. If teachers became experienced in using computers for teaching, they are very likely to continue such a practice. If they have realized the power and the ease of use of technology, they will be happy to use it. If teachers have conducted action-research using computers to teach, they will become actively involved and will definitely continue to grow with technology.

How we make teachers understand the significance of the research and hold positive attitudes toward research is the key to inspiring their enthusiasm and confidence in technology. The technology-based research by teachers is the best means to get teachers interested and involved. Teachers will not appreciate the technology-based research unless the research is closely related to their life and work.

Major research areas

Technology can be beneficial to education in the following ways: 1)fostering students' problem-solving and higher-order thinking, 2) enhancing student-directed learning , 3) providing diversity in instructional methods, and 4) becoming an effective management tool. To maximize the power of technology to serve education, teachers can research the following areas:

- How technology can make a difference in teachers' work.
- How technology should be integrated into curricula.
- Under what circumstances students can benefit from using technology.
- What key factors may contribute to effective teaching and learning in the content areas.
- How technology can increase collaboration and cooperation among students.

Teachers may also want to expand their research agenda to the relationship between school, parents, and community. Zehr (1997) points out that technology is making it easier for parents, business people, and community members to get involved in education. At the same time, it is forcing some educators to rethink what they mean by "school". In addition, some broader issues such as communication, effective management, and multicultural awareness may deserve serious attention.

Suggestions

Based on the above discussion, several suggestions are made below to enhance the technology-based teacher research.

- University teacher education programs should provide a realistic setting for teachers so that they can get actively involved in learning about educational technology as well as finding solutions to the technological challenges they are facing. Both university faculty and school teachers should examine the obstacles for technological implementation together.

- University should take leadership by providing a vision of what technology should be and which direction schools should go. University should also pay attention to the reality issues. Teacher education professors should provide teachers the learning experience that they can use in their school daily life. Technology will not be successfully integrated and thrive until teachers are convinced that technology is useful and easy to handle.
- Encourage teachers to polish their computer skills by taking courses, attending workshops, and conducting action research projects.
- Increase connection and communication. Connect the preservice students with the inservice students and bridge the experience gap between them. Help teachers collaborate with each other so that they can break the unnecessary isolation.
- Strengthen the ties between university teacher education programs and public schools by establishing collaboration between the university faculty and the public school teachers. We should encourage teachers to take initiatives to conduct action research in their own class while encouraging the university teacher educators to work collaboratively with school teachers so that they will stay in touch with the school reality.

Conclusion

Integrating Technology into the curriculum has become a national norm. However the current status of technology in education can be characterized by the scenarios that teachers are desperately in need of help to learn how to use technology and to integrate technology in their curriculum, and the university professors are out of touch with the reality in the public school. Although technology has been around in education for over two decades, it has not made a significant impact on education as it should be. To improve the current situation and to face the challenge of infusing technology in the school, this paper proposes a model to engage teachers in active empirical research in their classroom through which teachers can pick up needed technological skills and learn to tackle the challenges faced by exploring innovative ways to implement technology in their curriculum.

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Examining an Interactive Model of Learning for Telecommunication Instruction

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One of the principal challenges to the universities of the future is the changing nature of the student body. The term 'lifelong learner' is now part of the vocabulary of modern day society. It describes the need for people to continue their education and training throughout life. In the modern day society of multiple career changes and extended productive lives, the word 'learner' designates a role rather than a individual. The spreading culture of lifelong learning is even producing changes in the attitudes of the young traditional campus student. These students are demanding flexibility and individualization of the degree process to meet the complexity of their lives.

Higher education is beginning to change in response to these challenges. A new type of university has emerged in the last quarter century. It is the distance teaching university (Daniel, 1996). This distance teaching university may be a totally new university system like the Open University of the United Kingdom which was established in 1969 or the University of Phoenix accredited in 1978. On the other hand, distance teaching may be just receiving a new emphasis at an older traditional campus university like Penn State University, University of Wisconsin, Washington State University, here at Northern Arizona University, and a growing list of others. This is not to say that distance teaching is a new phenomenon. It is the recent developments of technologies within computing and telecommunications combined with the changing nature of the student body that has produced new interests in distance teaching (Daniel, 1996).

One of the most important issues that must be addressed immediately is the issue of quality. What about learning? In terms of distance *learning*, not teaching, the combination of computing and telecommunications with the cognitive sciences is potentially the most significant issue that must be addressed as many universities move into the distance teaching arena. The uniqueness of these new highly technologically enhanced teaching environments found in modern day distance education are presenting new challenges in terms of providing quality. Some work in the area known as social constructionism, with an "n", may provide some answers into producing quality learning environments in distance teaching.

To understand the possibilities of social constructionist theories in the distance education environment it is important to understand the foundations upon which it is built. The academic usage of the word constructionism expands on the concept known as constructivism (Shaw, 1996). In social and developmental psychology, constructivist models view the subject as a builder of knowledge, not a passive receptor, but an active constructor. Theorists such as Jean Piaget attempt to describe how this building process takes place in order to better understand childhood learning and development (Piaget, 1954). Constructionist thinking concurs with the constructivist viewpoint but highlights the notion that it is through the construction of shared outcomes or artifacts that learners engage in developmental cycles that facilitate conceptual change (Shaw, 1996).

"We understand 'constructionism' as including, but going beyond, what Piaget would call 'constructivism.' The word with the 'v' expresses the theory that knowledge is built by the learner, not supplied by teachers. The word with the 'n' expresses the further idea that this happens especially felicitously when the learner is engaged in the construction of something external or at least shareable...This leads to a model using a cycle of internalization of what is outside, then externalization of what is inside and so on. (Papert, 1990, p.3)

A strong emphasis is placed on created objects being external to their creator, as things "in the world" that can be "shown, discussed, examined, probed, and admired" (Papert, 1980, 1991, 1993). Evard (1996) states, "Sharing a creation can result not only in its refinement, but also in the learner obtaining a deeper understanding of other people's perspective on the object and on the ideas to which it is related."

Constructionism highlights the notion that through the process of constructing shared outcomes and artifacts, doors to understanding are opened. Social constructionism extends the constructionist view by stating that the social

relations and social activities are constructions themselves and have a major impact on the shared outcomes. To social constructionism, the social setting itself is an evolving construction. "When members of a social setting develop external and shared constructs, they engage the setting in a cycle of development that is critical to determining the setting's ultimate form..." (Shaw, 1996. p 177)

Social settings are not viewed as simply neutral grounds in which developmental activities take place, but they are seen instead as intimately involved with the process and outcome to that development. The impact of the social settings on learning is being recognized from many perspectives. According to Applebee (1996), the paradox of what he calls "knowledge-in-action" is that in order to learn something new, one must do what one doesn't know how to do. The way out of this paradox is to realize that learning is a social process, we learn to do new things by doing them with others. Applebee (1996, p. 1) argues, "that the power of education is intimately bound up in the social and cultural traditions within which education is set." When viewing the design of a curriculum in this light, then a curriculum provides for what Applebee (1996) calls "culturally significant domains for conversation." Applebee believes that the conversations that take place within these domains are the primary means of teaching and learning. He contends that the problem of curriculum planning is the problem of establishing a culturally significant conversational domain and fostering relevant conversations within it.

Social constructionism makes the claim that the individual AND the social setting are intrinsically linked and that learning is a matter of both shared constructions and social relations (Papert, 1980; Wilensky, 1991; Evard, 1996; Shaw, 1996). Constructionism offers an important extension of the constructivist viewpoints by arguing that individual learning is enhanced by shared constructive activity and social constructionism adds further harmony by revealing that learning is impacted by the social setting which is enhanced by the developmental activity of the individual. If the constructionist notion of shared constructions and social relations are key to quality learning, then social settings marked by fractured and limited social activity and less cohesive social relations, as is the case in many distance education settings, may present troubling learning barriers.

A Model

In trying to bridge the gap he observed between theory and practice, the Georgian poet Vladimir Mayakovsky wrote "....I want to insist that I offer no rules to make a poet, by following which he can write poetry. Such rules simply don't exist. A poet is a person who creates these very rules." (Mayakovsky, 1974, p. 14)

Like Mayakovsky's observation that there are no rules that, if followed, will always produce great poetry, there seems to be no rules that a teacher can follow which will always produce great learning. However, just as with poetry, there are parameters that exist that when constructed may create environments which increase the expectations that quality learning will occur. This paper examines a model that may help create those parameters, especially in a learning environment that is characterized by the teacher being separated from the learners and learners being separated from one another.

Connection Between Design and Learning

Recent efforts in the educational community have stressed the importance of self-directed, personally meaningful, and cognitively complex projects for students' learning success. One of the main tenets of constructionism is that learners actively construct and reconstruct knowledge out of their experiences in the world. Constructionist theory suggests a strong connection between design and learning.

> "...design involves building a relationship between designer and object. Designers sort out what objects mean to them or others; then they selectively connect features of an object and features of a context into a coherent unity. The relationships that designers build with objects or situations constitute the core focus of design theory; the final artifact is secondary. Design is now viewed as the process though which a designer comes to understand not only objective constraints, but also subjective meanings." (Kafai and Resnick, 1996, p4) (emphasis added).

Microworlds

The basic idea of social constructionism is that in the construction of shared outcomes or artifacts that facilitate conceptual change, a community is more intelligent than any of its members, including its leaders. The problem is how to mobilize community knowledge so that its members benefit from it. Perhaps an answer can be found in a concept called microworlds. Microworlds is based upon the concept of powerful ideas, or concepts that are useful in many kinds of situations. Papert (1980) developed the concept of microworlds to answer the critics of discovery learning. Two factors that limit discovery learning are inadequate design support and inadequate support for cooperative action (Gargarian, 1996). The solution for design support may come from a concept called "freedom in restrictions". The solution for cooperative action may come from a concept called "Confidence Building". If a model can be developed that facilitates the process of developing microworlds and facilitating the interaction of the community of learners, then it must provide a way that learners can identify a number of powerful ideas for engaging other learners and providing the framework by which the

expertise of a community of designers is placed at the service of each of its members.

Freedom in Restrictions

Designing is in large part redesigning or editing and refining. It is concerned with problems Gardner (1987) describes as open-textured. But therein lies a paradox, in designing there is no way to plan a path toward a solution if what constitutes a solution is, itself, under debate. The solution of designing is emergent rather than planned because the designer is learning what a "problem" is about during the process of design. For this reason if learners are to engage in designs that facilitate developmental cycles and conceptual change through the construction of shared outcomes or artifacts there must be a restricted design process.

> "Without restrictions, a designer would be unable to choose from the possible actions he could take; he would be paralyzed. Moreover, an action has little value if there is no way to evaluate the effect of the action. What I call*freedom in restrictions* is the counter-intuitive notion that restrictions provide the designer freedom rather than enslavement. Within a restricted collection of choices, a designer can explore choices...."(Gargarian, 1996, p. 132)

Confidence Building

Designing is a process in which provisional solutions serve as a means of further discovery. The designer needs strategies for identifying factors that restrict the degrees of freedom. These strategies come about through a process of feedback. Through this process certain factors may emerge as particularly important because it is important from many perspectives, not just the perspectives of the creator. The key is that the feedback, no matter what its form, comes from as many perspectives as possible. Gargarian (1996) refers to this as confidence building. It is how restrictions earn their credentials though feedback. Growing confidence makes some restrictions rigid and certain solutions decreasingly provisional. "Proof that certain artifacts become increasingly permanent is that they eventually get made" (Gargarian, 1996, p. 133).

Explication of the Model

The model considered in this paper was created by an educator with extensive experience in distance education, primarily IITV. He proposes a six step process in which students are responsible for shaping and reflecting on their own learning, actively engaging in the construction of knowledge. The stages of this model can be applied across the scope of an entire course or to topics within units or sections of a course.

We will begin with a brief summarization of the model as it is designed and move to a discussion of how the notions of microworlds, freedom in restriction, and confidence building as described by Papert (1980) and Gargarian (1996) are central to the examination of the a constructionist model of learning, especially as it applies to telecommunications courses.

The first stage of this model asks students to examine what they, bring to the learning process. Using their prior knowledge as the only avenue for approaching a specified topic, students are asked to generate a one page paper that delineates what they know about that topic. This piece of writing is the first entry into a portfolio of work that can be revisited and revised throughout the semester. Students are told explicitly that the purpose of this first assignment is to help them take control over their own learning by acknowledging what they already know and to shape the initial inquiry into the content of the course.

The second stage directs students to consult with other students in the course to discover areas of common ground, gain new perspectives, and extend knowledge about the topic. Students are urged to collaborate with as many other students as they can, both within and across sites. At the end of this consultation students are then asked to revise and reshape their initial papers to include the thinking constructed through collaboration with peers.

It is in the next stage in which students are allowed to consult texts and other "expert" resources that are readily available. Depth and breadth in the variety and types of sources available is encouraged. Students are not only guided to verify their original thinking but to treat resources as different voices in the conversation about the knowledge held about the topic. Think in terms of many voices, many sources (Bensusan, 1997). The students' task at the end of this stage is to compare their findings with those of other students and then to write a paper describing the fit between their previous work and what the experts have to say - whether this adds to what is known or not.

In the next several stages, students are asked to examine the topic from a number of different perspectives. Each perspective not only offers a different view of the content, but also requires students to examine sources of information in order to determine what each source brings to the construction of knowledge about the topic. Fields of study, schools of thought, background and expertise of authors, type of resource are considered by students at these stages. Students are encouraged to see how different authors and resources shape the world around or provide different contexts for the same topic that students are examining. This set of stages is capped by writings that refine and recast knowledge of the topic so that the richness of perspectives is voiced.

The culminating steps of the model ask students to resolve the differences in perspectives and reflect on how this process changed or enhanced their thinking about course content. Students are told that these steps are only the end of the course requirements, but that thinking and refining ideas are a lifelong process.

Creating Microworlds Within the Model

In telecommunication courses the participants may not only be separated from the instructor, but also from each other. It is essential that an environment, a microworld, be created that will help participants feel comfortable and confident about working together (Baird & Monson, 1988; Willis, 1994) as well as building support for the exchange of ideas, thoughts, and feeling, between and among people, resulting in new ways of viewing the world or in new ways of acting. (Lauzon, 1992). This model facilitates the creation of such an environment through it's treatment of each student as a valid contributor to the knowledge construction process. Every source of knowledge, course participants included, is acknowledged, considered, and scrutinized, but treated as one voice in the conversation around a topic. Students are not told what counts as knowledge, but must be actively involved in shaping and delineating the important aspects of content as it is constructed.

Freedom in Restrictions

A second strength of this model is that students are not left to figure out what is to be learned on their own. At each stage the model restricts the scope of the discussion and provides a scaffold for the types of thinking that must be done at that point in time for the learners to collaboratively shape conceptual change. Because the focus of a particular step is narrow in focus, students are allowed to explore boundaries in ways that would not otherwise be possible.

Confidence Building

If students are to be expected to take an active role in constructing knowledge about a topic, they must feel that the efforts that they put forth to learn has substance and worth. Students that are led to feel that they must wait for instructors to validate what they understand will never be able to participate fully in the learning process. This model allows students a variety of modes of feedback as well as the capability to continually reassess and reflect upon their own learning.

Conclusions

The model examined in this paper has the potential to enable students to be active participants in the learning of subject matter content, particularly in telecommunications courses where teacher and students are physically distanced from each other . Through the steps of this model students get first-hand experience in using multiple sources of information to construct their own knowledge. This knowledge construction hinges on the creation of a learning environment in which collaboration and the acknowledgment of different perspectives is not only honored but expected. The model illuminates ways in which the social environment and the individual are united in determining the boundaries for the types and the extent of learning that are possible within a telecommunications course and offers a workable scaffold for future study within this field.

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Content Analysis of Online Discussion in Educational Psychology Courses

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Computer-Mediated Communication (CMC) is an emerging research area in educational technology. The proliferation of research literature indicates various virtues and drawbacks (Ahern, Peck, & Laycock, 1992; Henri, 1992; Kuehn, 1994) in analyzing electronic discourse. Currently, most research studies use quantitative methodology to carry out online content analyses, whereas only a limited number of them employ qualitative tools (Romiszowski & Mason, 1996). This study applied both quantitative and qualitative criteria to analyze the content of computer conferencing and electronic collaboration.

Henri (1992), a pioneer in the development of criteria for content analysis, identifies five dimensions, namely participation, interaction, social, cognitive, and metacognitive, that can be used to classify electronic messages. Although his model provides an initial framework, it lacks detailed criteria for systematic and robust classification of electronic discourse. Howell-Richardson and Mellar (1996) have also pointed out that Henri's model is sometimes hard to apply as it is not always clear which dimension is the most suitable to use to classify messages. The main focus of our study was to analyze twelve weeks of electronic collaboration for the purpose of constructing better guidelines on how electronic discourse can be analyzed, thus improving Henri's existing model.

Research Questions

This study carried out a systematic analysis of online discussion in both an undergraduate and a graduate educational psychology course to better understand electronic dialogues. The main research question we investigated was "How is a community of learning built using online discussion?"

Research Site

Our research study look place at a major Midwestern university in the United States. The applied cognitive psychology class was chosen because it made use of the computer conferencing software, FirstClass. The undergraduate educational psychology course used a web-based conferencing tool called COW (i.e., Conferencing on the Web). In the graduate course, students met once a week and were required to participate in online discussions at least once a week. The undergraduate course was entirely Web-based.

In both courses, students were asked to play the role of a "starter," one who initiated the discussion for each week, or a "wrapper," one who summarized the conference at the end of the week. Students assumed each role at least once a semester. Research studies (e.g., Ahern, Peck, & Laycock, 1992; Howell-Richardson & Mellar, 1996) show that the teacher's role is also an important variable in computer-mediated communication, therefore the facilitator's role was also investigated in our study.

Research Methodology

Initially, Henri's taxonomy was used for analysis. When the model became too ambiguous and not adequate for capturing the richness of the discussion in a clear manner, more categories were added to it.

For the graduate course (referred to as Applied Cognition and Learning Strategies from here onward), twelve weeks of conferencing using FirstClass were analyzed quantitatively, and four randomly selected weeks were analyzed qualitatively. In addition, interactivity maps were drawn to depict the links between students' messages. To validate the coding procedures, two of the researchers coded the messages individually and observer agreement was calculated. The Web conference is currently in the process of being analyzed using the same framework.

For the undergraduate course, students in eight sections of an educational psychology class had nearly two months to create two cases of interest and respond to four or five other cases created by their peers. During their online discussions, students assumed a number of different roles such as starter, wrapper, questioner, sage, coach, pessimist, and optimist. In addition, undergraduate

students discussed with great interest their field experiences. During these discussions students primarily

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reflected on their experiences and compared how their field experiences related to what they learned from textbooks and classroom lectures.

Findings

Applied Cognition and Learning Strategies

The graduate level applied educational psychology course was analyzed using Henri's five dimensions: (1) participation; (2) social; (3) interaction; (4) cognitive; and (5) metacognitive.

Participation: The number of student messages exceeded the number of instructor's messages, a finding which indicated that this conference was student-centered. We considered two reasons to explain this. One was the fact that the roles of starter and wrapper were played by students. Additionally, the instructor was criticized by a student for too much participation, after which, he limited his participation. Most students posted at least one message per week in order to satisfy the minimum course requirements. Although this satisfied the instructor, on the average students did not make extensive use of the conferencing tool. This indicated that students participated in the online discussion primarily to meet a course requirement. Thus, the interaction was not a two-way interaction; instead it was a one-way interaction (see Interaction section below for detail).

Social. In the graduate level course, the number of social cues decreased as the semester progressed. Moreover, messages gradually became less formal. This might be attributed to the fact that students felt more comfortable with each other as the semester continued. The correlation between cognitive tasks and social cues was examined. Of the four weeks of cognitive analysis, the eighth week had the lowest number of social cues and the highest cognitive task frequency (88.1%), indicating that during the eighth week students engaged in intense online discussion and focused on the task.

Interaction. The concept of interactivity in Henri's model *consists* of three steps. They include: (1) communication of information; (2) a first response to this information; and (3)a second answer related to the first. This process can be represented schematically in the following manner:

A ======> B ======> A ======> B

The interaction in our conference appeared to be much more complex. First, most participants attended just once. This created a one-way interaction not a two-way one, because the students who initially started a discussion (message A) infrequently participated thereafter. Second, more than two participants were usually involved; therefore the interaction was not always linear as Henri's (1992) model suggested. After analyzing the interactivity graphs week by week, a unique pattern of interaction was found for each week. The following patterns were identified: (1) the second week had "starter-centered" interaction; (2) the fourth week had "scattered" interaction, and this can be explained by the fact that nobody assumed the role of the wrapper in the discussions that took place during the fourth week; (3) the eighth week had "synergistic" interaction; and (4) the tenth week had "explicit" interaction. As Ahern et al. (1992) noted, the starters' questions was one of the main factors in understanding interactivity (see Cognitive section below for detail). The other possible factor that influenced the characteristics of interactivity was the instructor's comments during class. Specifically, he encouraged students to reply to messages posted by their classmates. This might have affected students' behavior while participating in the conference.

Cognitive. As stated earlier, starters' questions influenced the quality of the cognitive tasks in the conference. Henri talks about five categories in the cognitive dimension. They include (1) elementary classification; (2) in-depth classification; (3) inferences; (4) judgment; and (5) application. In a highly interactive conference, participants' opinions appeared mostly in the beginning of the discussion rather than at the end of the discussion. This was due to the fact that early presenters discussed their individual positions, whereas later presenters judged the participants' opinions. Therefore, the cognitive engagement of the participants was also an index of how they interacted in the conference.

Metacognitive. Henri's taxonomy classifies tasks such as understanding ideas or remembering past learning as metacognitive activities. Even though all metacognitive activities identified by Henri, such as planning, self-awareness, and evaluation, appeared in this conference, we identified others. The processes of self-questioning and reflection (Schon, 1983) were added to the existing model. In addition, more detailed criteria such as the following were added: (1) self-introduction as self-awareness; (2) wrapping the discussion as regulation; (3) starting the discussion as planning; (4) short introduction of the message as planning; and (5) formatting headings in bold and color as regulation.

The undergraduate educational psychology course

Harasim (1993) claims that computer conferencing is a potential instructional tool. Content analysis showed that student electronic participation was extremely task-focused - minimal social and off-task behaviors were observed. In addition, students limited their contributions to the requirements of the course and did not engage in extended discourse on a particular topic unless it was required. Student questioning and cognitive processing varied and appeared somewhat dependent on how the instructor structured the task and how he scaffolded learning.

Furthermore, while graduate student dialogue showed critical thinking and rationale, at the undergraduate level, many electronic contributions lacked justification and were simply opinions. Not surprisingly, the level of cognitive engagement depended on the level of cognitive complexity established by the starter's questions and guidance. In fact, most discussions led directly back to the starter's comments and ideas. Hence, we conclude that it is important to train students how to start electronic discussions and how to provide various forms of electronic assistance to their peers.

Limitations

One weakness of this study was the lack of student interviews for the purpose of validating the researchers' interpretation of students' discourse. In addition, as Shapard (1990) also pointed out, only explicit communication was examined, as students' implicit intentions could not be robustly studied. Therefore, our analysis might have not captured the contributions of students who did not express their discourse explicitly in the conference.

Conclusions

Conferencing tools can help students understand complex terminology and theories in educational psychology classes. They are an emerging aid in applying psychology to education. Students, however, often treat them as means to complete a particular task, rather than engage in rich discussion and debate with their peers. Online analyses of student interactions show that such environments have the potential of becoming rich instructional and learning environments if they are designed appropriately. The recommendations that we have to offer to practitioners are: (1) Structure online discussions; (2) Use pedagogical strategies; (3) Foster student interaction; (4) Test the conferencing software to explore its limitations and possibilities prior to using it; and (5) Realize that different types of conferencing software and features serve different types of instructional purposes.

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My Teachers a Helper Now: Changing Dynamics in the Learning Process

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One teaching approach being trialled in the UK is the use of large scale semi-intelligent teaching packages. These so called Integrated Learning Systems (ILS), are computer-based systems which present individualized teaching at a level appropriate to the child and which is deemed to ensure reasonable success. An ILS incorporates a management system which provides instant feedback to students on the current task and access to progress reports which inform the students and their teachers of their rate of success during that particular ILS session.

The current interest in such systems is stimulated by the need to halt the perceived decline in numeracy and literacy within our schools. So important is this debate within the UK that the Department for Education and Employment has funded three phases of an evaluation project to establish whether or not such systems are efficient and effective tools for teaching and learning.

Such styles of teaching and learning are often deemed impoverished, however. Roy Pea (1993) has argued that the tutorial mode of learning inherent in an ILS is a poor model of learning. He does not argue that there will be an absence of learning but rather that such learning will be in some sense unsatisfactory or of low value. The accretion of facts or skills is deemed less beneficial than the type of learning fostered in an open-ended problem solving curriculum designed to hone the child's higher order thinking skills.

The argument for a social dimension to learning is well-established (see Howe *et al*, 1992; Kruger, 1993, Lave and Wenger, Rogoff, 1993; Underwood and Underwood, 1990, 1995). The first argument is that under positive contact conditions working in groups can facilitate interpersonal relationships which may in turn have positive effects on student motivation, self-esteem and academic learning. A more cognitive view would be that co-operative learning emphasizes cognitive interactions such as conflict resolution, hypothesis testing, cognitive scaffolding, reciprocal peer tutoring and overt execution of cognitive and meta-cognitive processes and modeling.

Children working in an ILS environment are not actively encouraged to communicate with, or to support, their peers. Indeed the model of use for much of the ILS work is one of individual or isolated work characterized by limited interaction with the teacher or other pupils. This inhibition of the rich interchange of ideas that are available in more socially oriented classrooms where co-operative or collaborative working is taking place is deemed a major limitation of the teaching and learning environment promoted by these systems.

Is it the case that these environments are zones of social deprivation? Does working with an ILS lead to negative social outcomes. We have written extensively about the strength and quality of the learning taking place in ILS classrooms elsewhere (Underwood & Brown, 1997) here we are focusing on the issue of whether or not these packages which promote individualized instruction have a detrimental impact on the social dynamics of the classroom. In particular we are looking at pupils' perceptions of their teachers.

This paper presents the preliminary analyses of perceptions held by pupils in the ILS project of their teachers' behavior in mathematics classrooms. Here we will outline the nature of the changes in the social dynamics of the classroom and discuss possible causal events leading to those change.

Method

The Question

Do pupils, exposed to an ILS working environment, have a different perception of their teachers and the teachers' role than children who have not participated in the ILS experience? Further does working in an ILS environment lead pupils to hold more negative perceptions of their teachers than non-ILS pupils?

The Sample

The study of pupil perceptions was conducted in all schools involved in the ILS Phase Two evaluation who were using CCC's SuccessMaker or Sir's Global Learning Systems software (for fuller descriptions see Underwood & Brown, 1997). Pupils in the ILS study were assigned by their own teachers to either the ILS intervention group or to

a Control group. Six secondary and four primary schools provided data for this part of the project.

Design and Procedure

For the present study the evidence was collected using a research instrument based on projective testing. This method consisted of a sentence completion technique with a cartoon drawing as stimulus. Two versions of classroom drawings were available. One set of cartoons asked the children to complete simple sentences as in Example One below. A second set of cartoons provided a context for the children's responses as in Example Two. Further, the cartoons were set in the context of either a primary (elementary) or a secondary (high school) classroom. Care was taken to alter the order of sentences presented to the pupils.

Example One: For primary (elementary school) pupils, the unfinished sentences included:

- One of the girls is saying .....
- One of the boys is saying .....
- The teacher is saying .....

Example Two: For secondary (high school) pupils, examples of the sentences included:

1. A boy has been messing about instead of doing his work. The teacher is saying .....
2. A boy has done his work well. A boy is saying to him .....
3. A girl has all of her work right. The teacher is saying to her .....

Both versions of the cartoons were distributed randomly to ILS intervention pupils and to Control pupils. The information given with the sentences stated either that the lesson was an English lesson, or that it was a mathematics lesson. Pupils completed the tests within their normal classroom environment which in all cases was separate from the ILS environment.

Corroborating evidence of pupils' perceptions was taken from observations of teachers' self-reports of their classroom practice and through structured interviews with pupils and teachers.

Results

Responses were categorized using classifications from Cavendish (1988) with some modifications to allow inspection of the responses in greater detail. The main categories were:

- Routine matters related to task e.g. here's a rubber
- Non-task matters
- Reference to difficulty or dislike of task
- Reference to ease or liking of task
- Praise for behavior
- Corrective related to behavior
- Praise related to task
- Corrective related to task work
- Asking for help on task
- Offering help on task
- Comradeship and giving emotional support
- Nastiness, scorn, competitiveness
- Comment about stage reached or amount of work done

Responses were compared for the ILS and Control groups. The perceptions of primary (elementary) pupils when commenting on their teacher working in a mathematics lesson are presented in Tables 1.

Table 1.
For Mathematics: Percentage of primary pupil responses to the question 'The teacher is saying...'

	ILS (N=44)	Control (N=30)
Routine matters related to task	6.8	20.0
Offering help on task	15.9	3.3
Corrective related to behavior	56.8	66.7
Praise related to task	4.5	3.3
Corrective related to task work	4.5	0.0
Comment amount of work done	4.5	0.0

Twenty percent of the Control group saw the teacher as informing or instructing the pupils about routine matters such as "Get your books out" or "Get some paper for the test". This compares with less than seven percent of the ILS pupils. ILS pupils, on the other hand, were more likely to express the teacher as offering help with the task "Look this is how to do it" and "I'll explain how to do it". Some ILS pupil responses did relate to the teacher commenting on the amount of work done or in making corrective comments related to the task work but the frequencies of these comments were low. About sixty seven percent of Control pupils expressed the teacher as being corrective to behavior compared to a lower fifty-seven percent of the ILS pupils.

These differences in responses are indicative of the relationship that has been established between pupils and teachers. The general observation of ILS rooms is of pupils working silently and continuously at a computer, with the teacher putting high emphasis on performance and gains made during the session and providing help where needed. There appears to be some carry over of behaviors from the ILS environment to the classroom at least as far as the pupils are concerned. Structured classroom observation has shown regular occurrence of corrective comments by the teacher in normal classroom teaching, and while there remains a substantial number of behavior correction comments from ILS pupils, the number is reduced.

While the Control groups see the their teachers' focus on routine matters or discipline, the ILS pupils comment that their teachers are focused on the academic work: offering help, praising about task work or commenting

about the stage of work the pupil is at or the amount of work done.

Table 2.
SuccessMaker Mathematics: Percentage of secondary pupil responses to the question 'The teacher is saying...'

In math and English classes the teacher says

	ILS (N=54)	Control (N=41)
Routine matters related to task	7.4	7.3
Offering help on task	20.4	24.4
Corrective related to behavior	53.8	53.7
Praise related to task	59.3	63.4
Corrective related to task work	13.0	4.9
Comment amount of work done	13.0	9.8
Nastiness, scorn or competitiveness	1.9	7.3

In SuccessMaker secondary (high) schools there were few differences between the ILS and Control groups perceptions of their mathematics teachers although a perceived greater emphasis on the task in hand by the ILS group was apparent (Table 2).

Table 3.
Global Mathematics: Percentage of secondary pupil responses to the question 'The teacher is saying...'

	ILS (N=54)	Control (N=41)
Praise related to behavior	8.0	0.0
Offering help on task	20.0	29.0
Corrective related to behavior	48.0	48.4
Praise related to task	60.0	64.5
Corrective related to task work	8.0	6.5
Comment amount of work done	4.0	6.5
Nastiness, scorn or competitiveness	0.0	3.2

In Global schools, ILS pupils were more likely to comment on teachers' use of praise in relationship to behavior (Table 3) than control pupils. The latter, however, viewed the teacher as offering help on the task, giving praise related to the task and as a support giver. The view of the teacher by the control pupil, in these Global schools was one of helper and supporter with pupils asking for help as well as being offered it by the teacher. The ILS pupils, however, were more likely to view their peers as helpers and who keep watch on the amount of work done. The ILS pupils certainly saw no lack of opportunities for social contact with their peers.

Corroborating evidence from teacher-self reports (Table 4) show that at both primary and secondary school level ILS-involved teachers reported an overall decrease in disciplinary interactions with pupils in their classrooms in general.

Table 4.
Teacher Self-Report on Occurrence of Specific Teacher Activities in Primary (Elementary) and Secondary (High) School Mathematics Lessons.

	Start %	End %	Sig level
Primary (elementary)			
As teacher I was involved in	78.6	29.4	0.01
discipline related interactions	(N=13)	(N=18)	
Secondary (elementary)			
As teacher I was involved in	74.4	51.0	0.05
discipline related interactions	(N=39)	(N=51)	

Figures record frequency as a percentage with which a teacher indicated whether an activity had taken place in the lesson they had just completed. They do not indicate the frequency with which that activity took place in any lesson. Analysis by Anova.

Conclusions

Primary pupils and Global secondary ILS pupils generally view their mathematics teachers as being more focused on work rather than on discipline and organization of the classroom. There were few apparent differences in ILS and Control pupils' perceptions of their teachers in SuccessMaker secondary schools although a perceived greater teacher emphasis on work related issues in the classroom by the ILS group was noted.

The major change in the social dynamics in such classrooms is the perceived need for the teacher to act in a negative, custodial role. Teachers argue such a role has been reduced because of a positive change in their pupils' behavior. They have a decreased need to discipline the children in their care. Pupils, on the other hand, increasingly view teachers as helpers, and hence they feel positive towards their work. A plausible conclusion of such pupils' perceptions is that better behavior will follow. Hence we are in a loop, as is so often the case in education, but in this case the loop is promoting positive impacts on the classroom.

Do pupils, exposed to an ILS working environment, have a different perception of their teachers and the teachers' role than children who have not participated in the ILS experience? Yes, there are subtle differences between groups. Further does working in an ILS environment lead pupils to hold more negative perceptions of their teachers than non-ILS pupils? No, where differences do occur, the evidence is that ILS groups are more positive rather than less positive about their teachers.

Our preliminary findings provide some evidence that working with an ILS does result in teachers focusing on

more content-oriented activities and on promoting effective learning rather than on the general organization and management of classrooms. Are the teachers over or under optimistic in their self reports of change? Further evidence will now be drawn from actual classroom observations of the teachers in classrooms to establish whether the pupil and teacher reports

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Computer Anxiety: A Technical or an Existential Problem?

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There is a proliferation of attempts, such as conferences, teacher professional development activities, and school or district Web sites chronicling "technologized" educational experiences, to address the issue of teaching and learning with technology. It is clear from such measures that technology is becoming part of the fabric of education in this country. Indeed, there is no lack of rhetoric describing the potential for technology to improve the education learners receive by enabling teachers to be more responsive to individual needs; helping learners develop a sense of connectedness to the world outside school; and providing access to the latest information, to name a few examples. On a related note, teachers feel pressure on many fronts, as they are the ones who must address the requests and suggestions of parents, administrators, and researchers for meaningful educational experiences for children that involve the use of technology.

However, "success" in teaching with technology can be difficult to achieve. This is so because institutional and individual resistance to technology is a frequent if unwanted byproduct of many attempts to incorporate technology use into existing school and district practices. Institutionally, physical plants may not be wired to support intense technology use, and bureaucracies designed to funnel information through a central location may prove inefficient in the context of technology use, where quick decisions are often necessary. Individually, student, teacher, or administrator experiences of computer anxiety (fear of working on computers), as well as beliefs that technology will actually decrease the quality of the education a learner receives, can prevent or hinder the smooth integration of technology into a classroom. This is not to say that teachers or school systems actively resist technology incorporation. However, existing school infrastructure and instructional mindsets often have the unwanted effect of hindering successful technology integration.

This paper takes a closer look atone of the phenomena associated with technology resistance computer anxiety. It examines the technology experiences of roughly 50 undergraduate education students, from whom data were collected by means of a computer anxiety survey (Marcoulides, 1989), short answer responses to more open-ended questions, and several in-depth follow-up interviews about students' expectations about using technology, specifically the Internet, in their teaching. Results indicate that the traditional definition of computer anxiety (Cohen & Waugh, 1989; Dukes, Discenza, & Couger, 1989), which links it very closely to *actually* working on a computer, is limited in its capacity to explain the experiences and beliefs of these students. Rather than fearing that they would not be able to perform specific functions on the computer, the participants reported more general fears that the use of technology, specifically the Internet, would conflict with their capacity to teach in the way they felt was most meaningful for students. In other words, they believed that the use of technology did not coincide with their goals as teachers: that it would restrict interpersonal contact and expose their students to inaccurate and unverifiable information. The phrase "existential computer anxiety" was coined to describe this experience.

These results suggest that it is important to consider the context in which technology is expected to be used. Participants in this study did not perceive themselves to be afraid of using computers. However, in the context of the classroom, many of them expressed reluctance to use the Internet with their students because they perceived that its use conflicted with their beliefs about teaching and learning. The authors of the paper hope to begin to develop a clearer picture of the pitfalls associated with technology adoption, specifically those related to what has narrowly been described as computer anxiety. It is our belief that the concept of existential computer anxiety more accurately describes some of the experiences of teachers and pre-service teachers who are expected to use technology in their teaching. In developing an understanding of the nature of existential computer anxiety, perhaps we can help teachers move beyond it and use technology in the service of meaningful learning.

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A Research Framework for Investigating the Effectiveness of Technology on Educational Outcomes

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Clark stated that, "...media are still advocated for their ability to increase learning when research clearly indicates that such benefits are not forthcoming. Of course such conclusions are disseminated slowly and must compete with advertising budgets of the multi-million dollar industry which has a vested interest in selling these machines." (1983)

Although this statement could be considered cynical in its emphasis, the question of whether the benefits of technology in education are forthcoming are still arguable, almost 15 years after this statement was made. This could be taken as a reflection on the lack of valid research into this issue. However, the emphasis on computer based technology in education has not abated, and, in fact, continues to increase. This is particularly so when considering distance education. In 1994 $2.4 billion was expended on educational technology in kindergarten through 12 grade and $6.0 billion in higher education. Higher education alone has spent some $20 billion over the past 15 years (Katz et al, 1995).

Jones and Paolucci (1996) estimate that less than 5% of published research is sufficiently empirical, quantitative and valid to support conclusions with respect to the effectiveness of technology in educational learning outcomes. They argue that the influence of technology, while substantial, is largely unfounded and serious consequences may result if the sustained acceptance of technology in educational delivery continues without considering the appropriate application. They questioned the untested educational quality resulting from relatively unproven paradigms involving technology and the questionable cost benefit associated with this continuance. Their conclusion was a call for further research concentrating on the application of*appropriate* technologies to the learning outcomes of the subject matter to which technology is applied.

This paper continues the theme of this argument. While substantial research exists which identifies components of various teaching/learning models, few suggestions have been made to identify a framework which would help to guide a unified research agenda contributing to the formulation of a technology/content matrix. This matrix, by its nature would allow the identification of relevant technologies to be applied to*appropriate* content.We identify a matrix of taxonomies, which would provide a framework for researchers to identify and target of specific work and ultimately contribute to a more complete solution.

Evaluation Framework

What is the most appropriate technology to use? In what educational context is a particular technology most effective? How effective is the chosen technology? The answers to these questions are critical in establishing the value added to the student's learning and achievement with the use of educational technology. However, with too many evaluation research studies, these questions are rarely addressed. And, if they are, the results are often unclear, due to the lack of a clear evaluation framework.

In order to address the above questions, we believe that the use of a system-oriented approach to educational technology evaluation is critical. Thus, our evaluation framework is based on the use of widely accepted and researched Instructional Systems Design (ISD) models. Although there are many ISD models: Gagne, Briggs, and Wager (1992); Smith and Ragan (1993); Kemp, Morrison and Ross (1994); R2D2 (1995); Reiser and Dick (1996); Dick and Carey (1996); Seels and Glasgow (1997), they all have life-cycle phases that include: analysis, design, development, implementation, and evaluation (Seels and Glasgow, 1998). Although some of these provide guidelines for selecting media and delivery systems (Kemp, Morrison, and Ross, 1994), they do not adequately address the technology dimensions and how these may relate to learning outcomes.

In response to this shortcoming, this study will focus on the dimensions of the delivery system and technology. It will present a general framework that can hopefully guide researchers in establishing a clearer relationship among instructional objectives, the choice of technology-based delivery system, and learning outcomes.

Instructional Systems Model

As mentioned above, to evaluate the effectiveness of educational technology, it is critical that a systematic approach be used. In its most general form, an instructional system can be viewed to consist of three major components: Instructional Objectives (Input), Delivery System (Process), and Learning Outcomes (Output).

Instructional Objectives

Learning is achieved when a permanent change in thinking, attitude, or behavior is experienced. Therefore, the objective of any instructional system should be to facilitate this process. It should be noted, however, that learning is an internal process which can only be done by the student. For many formal learning situations, an instructional system does not happen by serendipity. It requires significant planning and a sophisticated decision-making process. This process begins by clearly identifying a set of instructional objectives and goals. All instructional objectives can and should be based on one or more of the following factors: learning domain, learner profile, task characteristics, and grouping. These dimensions are described below.

Learning Domain. The instructional objectives should correspond to one or more learning domain(s). There are three basic domains of learning: cognitive, affective, and psychomotor. Taxonomies have been widely used to define learning within each of these domains. The most popular ones by Bloom (1956) for the cognitive domain, Krathwohl (1964) for the affective domain, and Harrow (1972) for the psychomotor domain. In practice it is very difficult to separate these, although it is possible to clearly emphasize one over the others.

Learner Profile. The instructional objectives should be appropriate for the learner's level of ability. Many learners may need prerequisite skills and knowledge for success with any delivery system. Key information about the learner characteristics can be used to develop a profile. It is recommended that, as a minimum, such a profile should include information on cognitive style, aptitude and ability, relevant experience, educational status, level of achievement with subject domain, attitude, interest level, age, and gender (Seels and Glasgow, 1998).

Task Characteristics. The instructional objectives should be appropriate for the tasks associated with the subject matter that is to be learned. A clear description of the topic to be learned, and the steps necessary to achieve this, can lead to clear instructional objectives. Task analysis is frequently employed to achieve this goal. Its purpose is to define the operational components of a skill or subject matter (Jonassen and Hannum, 1995).

Grouping. The instructional objectives should be appropriate for the grouping arrangement and learning situation. This can be simply determined by deciding whether the instruction will be with a large number of students, small or just one individual. Additionally, it is necessary to identify whether the instructional objectives require independent or group study, and the physical locations of the students.

Many technologies can provide support opportunities for all of the above options. However, research shows that the inherent properties of some technologies have more affinity for supporting some factors over others (Seels and Glasgow, 1998).

Delivery System

The delivery system is the method used by the instructional system to transfer information and knowledge from the subject matter expert (human and/or machine) to the learner or vice versa. The choice of the "optimal" delivery system should be made only after the instructional objectives have been clearly identified and specified. In general, the delivery system can either employ older and more traditional technologies (print, audiovisual, etc.) or newer technologies (computers, telecommunications, etc.), or a combination of both (Seels and Glasgow, 1998). Although both the older and the newer technologies continue to coexist as possible alternatives, the focus of this study is on the newer, electronic technologies. Furthermore, older technologies are increasingly being incorporated in newer technologies (e.g., video and audio information can be delivered by cassettes or by multimedia computer software such as CD-ROMs).

Today, most of the delivery systems are highly integrated information technologies, with the computer playing a pivotal role. They incorporate two major classes of technologies: telecommunications (e.g., teleconferencing, Internet, etc.) and multimedia/hypermedia computing (e.g., CD-ROM, World Wide Web, etc.). These technologies (whether used together or separately) are often used for distance learning and can provide individualized, interactive, and multi-sensory learning experiences. They have the advantage of learner control features, which can allow for interactivity. They can be used to access information and people either linearly and/or randomly, as well as locally and/or remotely. Moreover, they are capable of integrating media of many different types from many different sources, all within the control of the system software and/or learner (Seels and Glasgow, 1998). We believe that these digital delivery systems, when used as components of an instructional system, have major characteristics and dimensions that effect the educational experience. These characteristics include control, presence, media, and connectivity.

Control. The level of interactivity is a measure of the amount of control a learner has in the learning process and over the information source. With many instructional systems, this interaction is complicated by the inclusion of digital technology. That is to say, with the use of technology systems, one needs to determine the relationship to the traditional instructor-learner dyad (Branson, 1997). These

instructor-technology-learner relationships can be categorized in terms of the following configurations:

Instructor as Lecturer: The instructor has direct control over the learning activities and the technology and content, while the learner does not (e.g., audio-visual technologies, programmed instructional software)

Instructor as Facilitator: The instructor has direct control over the learning activities and indirect control of the technology and content, while the student has direct control of the technology and content (e.g., hypermedia, World Wide Web)

Technology as Mediator: The instructor and learner dyad is mediated by the technology, with the instructor having indirect control over the learning activities, and both the instructor and learner having direct control of the technology and content (e.g., teleconferencing, computer conferencing)

Technology as Tutor: The instructor plays little or no role over the learning activities and has no control of the technology, the learner has complete control of the learning activities and the technology and content (e.g., intelligent tutoring systems, simulations)

Furthermore, in those cases when the learner can directly interact and control the technology and content, one should be able to identify the locus of this control. That is to say, one needs to determine whether the control over the content resides predominantly with the instructional technology (system control), with the learner (learner control), or somewhere in between (both).

Presence. Digital technology systems provide the means for the instructor and learner to come together physically or virtually, synchronously or asynchronously. These modes can be characterized along two dimensions: space or location and time. The possible combinations of these two dimensions yield the following possible spatio-temporal configurations (Hedberg, Brown, and Arrighi, 1997):

Same-place/Same-time: Instructional and learning activities are synchronous and instructor and learner are co-located. Typical technologies available for this configuration may include all computer-assisted and programmed instruction.

Different-place/Same-time: Instructional and learning activities are synchronous and instructor and learner are remotely located. Typical technologies available for this configuration may include MUD's (Multi-User Dungeons), On-line chat systems, and many types of computer-conferencing systems.

Different-place/Different-time: Instructional and learning activities are asynchronous and instructor and learner are remotely located. Typical technologies available for this configuration may include electronic mail, Internet Usenet (newsgroups), and electronic bulletin boards.

Same-place/Different-time: Instructional and learning activities are asynchronous and instructor and learner are co-located. Typical technologies available for this configuration may include tutoring systems and simulation software.

It is obvious that the choice of any of the above modes of deliveries will require an "appropriate" choice of technology. It is a commonly held view that some are more appropriate than others. However, the level of technology effectiveness in enhancing the instructional and learning processes remains to be seen, especially with distance learning (Recker, 1997).

Media. Digital technology systems allow for the dynamic access and processing of a multitude of media types (multimedia). These multimedia types commonly include text, audio, graphics, and video, and are usually interactive (e.g., CD-ROM, DVD). Furthermore, when these media are dynamically linked or hyperlinked, they allow for significant learner control over the information. Finally, increasingly, these media are becoming immersive, where the information can be presented in three-dimensional space, allowing the learner to interact with a virtual environment (e.g., virtual reality, simulations). In general, the choice of media is highly dependent on the specific learning context (Kozma, 1991). However, much research is still needed, especially with hypermedia and virtual reality technologies.

Connectivity. Digital technology systems allow for the interconnection of people and information resources. More specifically, they can be designed to facilitate and support communication, collaboration, coordination, and cooperation among members of groups. These technologies are often referred to Computer-Mediated Communication (CMC) and GroupWare. Presently, the Internet is the network of choice with educators to connect instructors, learners and information on a global basis. Furthermore, with the popularity of the World Wide Web, this information can be hypermediated, highly unstructured, and readily available. Consequently, we are currently experiencing an explosion of Web-based instructional systems. The Web has suddenly become the de-facto, global technology platform for instruction and learning. Although Web-based instruction is the fastest growing area of educational technology research, we know little about how to effectively design and implement these systems for educational applications (Romiszowski, 1997).

Learning Outcomes

The assessment of learning outcomes provides the major feedback mechanism within the instructional design process. It is critical in evaluating the instructional system and its effectiveness. The information that is collected as evidence of learning achievement will depend on the nature of the competency being measured. Usually, these

consist of cognitive tests (measurements of intellectual skills), performance tests (measurements of capability), and attitudinal test (measurements of disposition and perspective). Additionally, the instrument and technique used to assess these outcomes will also depend on the learning domain and objective — written tests for cognitive objectives, portfolios for performance objectives, and interviews for attitudinal objectives (Seels and Glasgow, 1998).

The use of Bloom's Taxonomy of Educational Objectives (Bloom, 1956), as an example, provides a widely accepted and researched framework for evaluating cognitive abilities. These include knowledge, comprehension, application, analysis, synthesis, and evaluation. Furthermore, often, these cognitive skills are classified as lower-order (knowledge, comprehension, and application) and higher-order (analysis, synthesis, and evaluation). Assessment tests based on Bloom's Taxonomy have been effectively employed to measure the effectiveness of educational technology on cognitive learning (Paolucci, 1996).

Finally, too many educational technology evaluation studies minimize the cognitive domain (Jones and Paolucci, 1996). In general, all learning objectives have a cognitive component associated with them, whether these are primarily behavioral or affective in nature. In general, we think that cognitive tests are particularly important in the assessment of learning and technology and, therefore, they should receive much more research attention that they are presently given.

Conclusions

In this paper we have attempted to define a framework which brings together the multiple dimensions of integrating technology with the learning process. Our goal is to establish the relationships amongst the various dimensions of instructional objectives, delivery system, and learning outcomes. This is done with the aim of identifying the need, and laying a foundation to allow controlled studies that contribute meaningful inputs to the open question on the effectiveness of technology on learning outcomes. Only through systematic research and assessment will we identify the appropriate technologies to deliver specific learning objectives and materials. This framework was developed to provide some guidance in the development of this research agenda.

This is a first stage in providing meaningful answers to these questions. Jones and Paolucci (1996) identify that less than 5% of research completed to date may contribute in this respect, which leaves substantial work for the future. In fact, it is this lack of research, addressing the specific mix of the dimensions discussed that warrant this type of academic discourse.

Additionally, while this framework addresses the teaching learning process and the potential for technology to contribute to the system, it ignores what may be a major consideration that at some point must be considered in a full multi-dimensional analysis. That is the issue of cost effectiveness. Given the investment in technology, we must at some level consider the incremental cost of adding technology to the process and the value added to the learning outcomes by the expenditures made. This may indeed be the most difficult of all dimensions to assess.

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Considering Student Attitude about Information Technology in Planning Education Courses

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Student's attitudes toward information technology have been shown to be a major factor affecting their success in learning and using such technologies (Francis & Evans, 1995; Freedman & Liu, 1996; & Liu, 1997a). The most common studies relating to student attitude and technology appear to focus on examining possible differences in attitude across gender and age groups (Lockheed, Nielson, & Stone, 1985; Elkjaer, 1992; & Klein, Knupfer, & Crooks, 1993). Research further suggests that a better understanding of the differences in attitude toward information technology among students of different majors would be helpful for educators in planning information technology courses or designing training programs (Liu & Fernandez, 1997). The purpose of this study is to examine such major-related attitudinal differences among teacher education students. Specifically, we have examined attitudes toward information technology between preservice teacher education students who are seeking elementary certification (elementary-major) and those who are seeking secondary certification (secondary-major).

Attitudes toward information technology can be viewed as a many-faceted variable, for it is difficult to define a single variable called attitude. A review of the literature suggests that researchers have compared student attitude toward information technology using a variety of variables. A common group of variables include: (a) enjoyment—the degree to which students enjoyed learning and working with a computer (Cooper & Stone, 1996; Temple & Lips, 1989; King & Bond, 1996); (b) motivation—the degree of motivation students have when they learn and use the computer (Kellenberger, 1996; Clarian, 1993); (c) importance—the extent to which students see learning and using the computer as important (Corston & Colman, 1996); and (d), freedom from anxiety—the degree to which students feel anxious while learning and using a computer (Liu, 1997b; King & Bond, 1996; Ayersman, 1996). The literature suggests that all of these variables are related to student learning with and about computers.

For the purposes of this study, elementary-major students' and secondary-major students' attitudes toward information technology were compared on four variables described above: (a) enjoyment, (b) motivation, (c) importance, and (d) freedom from anxiety.

To obtain information about preservice teacher education students' attitudes that could be helpful in planning instruction, elementary-major students were compared with their own group on their attitudes toward information technology their attitudes toward the subject disciplines of mathematics, science, language, and social studies. The same comparisons were made for the secondary-major students. Finally a similar comparison was made involving the total group (elementary-major and secondary-major students combined).

The research questions for this study were:

1. Is there an overall difference in attitudes toward information technology between elementary majors and secondary majors?
2. Do elementary and secondary preservice education majors differ on the attitudinal variables of enjoyment, motivation, importance, and freedom from anxiety as they relate to learning and using information technology in education?
3. Do elementary majors differ in their attitudes toward information technology as compared to their attitudes toward the subject disciplines of mathematics, science, language, and social studies?
4. Do secondary majors differ in their attitudes toward information technology as compared to their attitudes toward the subject disciplines of mathematics, science, language, and social studies?
5. Do preservice education majors in general (elementary and secondary) differ in their attitudes toward information technology as compared to their attitudes toward the subject disciplines of mathematics, science, language, and social studies?

Based on the findings of previous studies, it was hypothesized that (a) a difference in attitudes about information technology between elementary majors and

secondary majors would be found, (b) elementary and secondary majors differ in at least one of the four attitudinal variables, (c) elementary-majors' attitudes toward information technology would differ from their attitudes toward at least one of the four subject disciplines, (d) secondary-majors' attitudes toward information technology would differ from their attitudes toward at least one of the four subject disciplines, and (e) the attitude of all the students about information technology would differ from their attitudes toward at least one of the four subject disciplines.

Method

Subjects

The subjects in this study were 208 teacher education students enrolled in the College of Education at the University of Nevada, Reno. These students ranged in age from 18 to 53 (the average age was 24.29). Of these students, 138 were female and 70 were male, and 112 were elementary preservice education majors and 96 were secondary majors. Most of the students had no computer experiences.

Instrument

The instrument used in this study was derived from Aiken's (1979) attitude scale, a Likert-type questionnaire consisting of 24 statements designed to measure the four attitude variables described above. The instrument has been demonstrated by many studies to be a valid measure of each of the four variables independently (Aiken, 1979).

Data Analyses

Repeated measures analyses were conducted to examine the research questions described above. The assumptions for repeated measures were checked and no significant violation of the assumptions was found.

Results

Repeated Measurement I

This repeated measurement analysis compared the attitude scores of the two groups of students (elementary majors and secondary majors) and is referred to as MAJOR in Table 1, on the four attitudinal variables considered the levels in this analysis and referred to as ATTI in Table 1. Based on Aiken's studies, the Fixed Effects table was used to present the results of this analysis (see Table 1).

Table 1.
Tests of Fixed Effects

Source	NDF	DDF	Type I F	Pr > F
MAJOR	1	203	18.24	0.0001
ATTI	3	617	46.20	0.0001
MAJOR*ATTI	3	617	6.22	0.0004

The results show that the difference between elementary and secondary majors' attitudes toward information technology is significant ($F = 18.24$, $p < 0.0001$; and $t = -4.27$, $p < 0$. The negative t value of -4.27 indicates that secondary majors have more positive attitudes toward information technology (higher attitude mean scores) than elementary majors.

The Differences of Least Squares Means from the analysis also show that significant differences were found between elementary and secondary majors at the levels of enjoyment ($t = -5.07$, $p < 0.001$), and freedom from anxiety ($t = -4.50$, $p < 0.0001$). No significant differences were found between the two groups of students at the levels of importance ($t = -1.60$, $p < 0.2610$) and motivation ($t = -1.60$, $p < 0.1096$). The two significant t values are negative (-5.07 and -4.50), indicating that secondary majors have higher mean attitude response scores at the levels of enjoyment and freedom from anxiety than elementary majors.

The interaction between the groups of students and attitude levels was found to be significant ($F = 6.22$, $p < 0.0004$). The difference between the two groups of students' attitude mean scores at the enjoyment level is different from that at the importance level and the motivation level.

Repeated Measurement II

This repeated measurement compared the two groups of students (elementary and secondary majors) on their attitude scores for five subject disciplines: information technology, mathematics, science, language, and social studies, which is referred to as COURSE in Table 2.

Table 2.
Test of Fixed Effects

Source	NDF	DDF	Type I F	Pr > F
MAJOR	1	204	1.98	0.1613
COURSE	4	821	17.95	0.0001
MAJOR*COURSE	4	821	3.94	0.0036

Table 2 shows that the interaction is significant; that is, the differences between the two groups of students in certain courses are different. Secondary majors had higher attitude scores in information technology (mean 94.14) than elementary majors (mean 86.90), but had lower attitude scores in language (mean 86.43) than elementary majors (mean 93.72).

The results also show that elementary-majors' attitude scores on information technology are higher than their scores on mathematics ($t = 4.16$, $p < 0.0001$) and science ($t = 2.81$, $P < 0.0051$), but lower than their scores on language ($t = -2.33$, $p < 0.0201$). There is no difference between their attitude on information technology and social studies ($t = 0.32$. $p < 0.7489$).

For secondary majors, their attitude scores on information technology are higher than their scores on language ($t = 2.42$, $p < 0.0156$), mathematics ($t = 5.84$, $p < 0.0001$), and science ($t = 2.45$, $p < 0.0144$). There is no difference between their attitude on information technology and social studies ($t = 1.75$, $p < 0.0796$).

For the total group (elementary and secondary majors combined) the significant differences were found between their attitude toward information technology and their attitude toward mathematics ($t = 7.11, p < 0.0001$) and science ($t = 3.71, p < 0.0002$); and there is no difference between their attitude about information technology and language ($t = 0.20, p < 0.8380$) and social studies ($t = 1.51$, $p < 0.1320$).

Conclusions

The results of our analyses answered all the research questions and confirmed the research hypotheses set forth in this study. The findings from the study can be summarized as follows:

1. Secondary preservice teacher education students have more positive attitudes toward information technology than elementary preservice students.
2. While secondary teacher education students do not seem to view learning about and using computers as more important and are no more highly motivated than their elementary counterparts, they do seem to enjoy their learning experiences more and feel less anxious about using computers.
3. Elementary teacher education students seem to have a more positive attitude toward the subject of information technology than toward mathematics and science, but they seem to feel less positive about information technology than they do about language as an academic area of study.
4. Secondary preservice students have more positive attitudes about the study of information technology than they do about the study of language, mathematics, and science.
5. When all of the preservice education students were combined, the data showed that they were more positive about information technology than they were about mathematics and science, while there was no difference between their attitude about information technology and language and social studies.

Taking the position that students' attitudes toward the study of any subject influence how fast and how well they will learn that subject, the results of this study suggest that teacher education majors will master topics related to information technology quickly and efficiently, while those who intend to teach at the secondary level will tend to be more highly motivated to learn about information technology and less anxious about using computers than those who intend to teach at the elementary level. Therefore, when planning information technology courses in education, teacher education professors may want to plan ways to help elementary majors build a more positive attitude toward technology. Part of the difference in attitude found in this study may be due to the tact that it is easier for secondary majors to envision ways they will be able to use information technology in their future classrooms. If this is the case, the attitudes of elementary majors might be improved by exposure to an array of technology applications in the elementary classroom. Another factor that might make learning to use information technology a better experience for elementary majors would be to present information and plan exercises designed to make them feel less anxious about using computers and related technology.

Two interesting conjectures can be made from this study. The first conjecture is that teacher preparation students feel positive about their learning experiences with information technology partly because most of these experiences have a major hands-on self-paced component. If this is true, incorporating similar learning experiences in other subjects such as math and science might improve students attitudes towards these subjects. A second conjecture is that students see learning to use information technology as a relevant and meaningful experience. If this is true, learning experience in other subjects might be enhanced by incorporating technology into those subjects.

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A NEW APPROACH TO SUPPORTING REFLECTIVE, SELF-REGULATED COMPUTER LEARNING

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Teacher preparation programs in colleges of education around the country are engaged with the challenge of preparing graduates to teach with technology in our nation's schools. This challenge is, and will become increasingly, an important issue for teacher preparation programs as they respond to demands for technologically prepared teachers in schools. These demands have come from a variety of sources: from recommendations and legislation at the federal level (Goals 2000: Educate America Act (P.L. 103-277), to individual state and local initiatives (Office of Technology Assessment, 1995). For preservice teachers, these expectations for learning to teach with technology will require continuous learning throughout their inservice careers, particularly in light of the rapid pace of technological innovations in education. In fact, the Office of Technology Assessment (1995) found that the majority of inservice teachers who successfully integrate technology into their teaching were not taught how to do this in their teacher preparation programs. These practicing teachers have learned about new technologies, learned how to use them, and then adapted them for use in their classrooms after entering the work force. Often, this process required extensive individual work, even if the teachers were provided with some inservice training, further underscoring the independent nature of developing proficiency.

The need for self-directed learning is additionally impacted by the knowledge that networked computers have particular affordances and constraints. Most current computer interfaces assume interactions with a single individual who controls the mouse, keyboard and menu selections or commands. Learning to work with such individualistic interfaces typically requires hands-on experience and most learners would work alone for the majority of these experiences over the course of a three-year program in teacher preparation and in the years to follow. This kind of environment assumes that a learner who knows how to be self-directed and independent will be more successful than one who is dependent on structured guidance. Independent learning settings do, however, offer the learner more choice and control over the process and pace of learning.

Given the centrality of self-directed lifelong learning to any acceptable model for preparing teachers to use technology, it is essential that the model be grounded in theoretical perspectives that can be used to inform the discourse about continued learning. Research on self-regulated learning in academic settings has provided new directions for theory and practice that show promise for application to settings beyond the K-12 classroom. In defining self-regulated learning, most theorists would agree with Zimmerman's (1986) portrayal of students as "metacognitively, motivationally, and behaviorally active participants in their own learning process" (p. 308). Much of the research on self-regulated learning has derived from the study of expert learners in a variety of domains and the subsequent distillation of the knowledge and skills that these individuals possess. As these qualities were explored and identified, researchers attempted to develop ways to teach students how to become more self-regulated. Although students in K-12 schools have been the focus of this teaching, the enduring benefits of self-regulated learning are especially well-suited for transfer to teachers who are learning to use computers and technology in their teaching for several reasons.

According to Ertmer and Newby (1996), metacognition and self-regulated learning strategies are essential to the performance of expert learners who are faced with solving problems in new domains. In novel situations, an understanding of "how" to learn by using specific cognitive skills and strategies distinguishes expert learners from novices who may have an equal unfamiliarity with the content of the domain. If learning to use computers, new software, and information technologies in teaching is considered to be a domain that inservice teachers should be comfortable with, it is also an area that is uniquely fraught with novel learning situations and therefore may be particularly responsive to self-regulated learning strategies.

Perhaps one of the most compelling reasons for the encouragement of self-regulated learning is the potential to enhance perceptions of self-efficacy or control over the learning process (Zimmerman, Bonner, & Kovach, 1996). As new technologies such as the World Wide Web emerge quickly, no one, including teachers, will have had experience with them. For some teachers, the gap between their perceived technology competence and learning to use computers in their teaching is often threatening and overwhelming. Given the knowledge that many teachers are also novice computer users, teachers who are reflective and self-regulated in their efforts to learn to use computers in their teaching, regardless of their level of technology proficiency, may be more likely to engage this task rather than avoid it altogether.

At this point, a further exploration of self-regulated learning with a particular emphasis its metacognitive elements is warranted. In Zimmerman's (1986) three-part model of self-regulated learning, metacognition, motivation, and behaviors or actions all play significant and interrelated roles:

> Metacognitively, self-regulated learners are persons who "plan, organize, self-instruct, self-monitor, and self-evaluate at various stages of the learning process." Motivationally, self-regulated learners perceive themselves as "competent, self-efficacious, and autonomous. Behaviorally, self-regulated learners select, structure, and create environments 'that optimize learning" (p. 308).

According to this definition, metacognition is viewed as one of the component processes of self-regulated learning. It also provides the second theoretical perspective that frames this research. In a paper that addressed continuing motivation to learn, McCombs (1984) proposed one way to view the relationships between self-regulated learning, motivation, and metacognition.

> In order to maintain learning interest and implement specific self-directed or self-motivated learning skills and strategies, it is necessary for students to know themselves, what's important to them, and their learning competencies and abilities. ....That is, a metacognitive self-awareness is an integral component of continuing intrinsic motivation to learn. This self-awareness contributes to perceptions of personal competency and control in both a general and a specific sense (p. 200).

As defined by Flavell (1976), who figured prominently in initiating this line of research with work on metamemory, "'Metacognition' refers to one's knowledge concerning one's own cognitive processes and products or anything related to them, e.g., the learning-relevant properties of information or data" (p. 232). Furthermore, Flavell (1981) proposed that metacognition can be differentiated into metacognitive knowledge, experience, and strategies (p. 38).

If self-regulated learning is particularly applicable to learning in new domains such as technology, then teacher preparation programs should conceive of ways to support preservice teachers as they develop the relevant knowledge, skills, and strategies for this kind of learning. Essentially, there must be a focus on fostering those characteristics and habits that will endure in domains of continuous change and innovation such as learning to use technology. To that end, the present study details the development of an innovative approach used during a one-semester course that might be replicated and expanded for use in teacher preparation programs spanning several semesters.

Of all the possible metacognitive and self-regulated learning constructs and strategies, metacognitive knowledge and experiences were selected as the primary foci of this research for two reasons: (a) metacognitive knowledge and experiences can precede and initiate metacognitive actions (Flavell, Miller, & Miller, 1993) and self-regulated learning strategies (McCombs, 1984), and (b) metacognitive knowledge and experiences also may require less explicit instruction and time than the more action-oriented elements, a feature that is a good match for the limited amount of time that teacher educators have with students during a one-semester course.

The potential for metacognitive constructs and theories of self-regulated learning to inform practice rests heavily on their application during the preservice teacher preparation years when there are opportunities to teach and support the habits of self-directed learning. To that end, this study sought to investigate ways in which individual characteristics associated with learning to use computers could be used as pedagogical tools for metacognitive reflection once preservice teachers are aware of them. Although many studies over the last two decades have investigated a variety of individual characteristics, five sets of characteristics were selected for their potential to change through experience and instruction. The characteristics that were studied were (a) computer attitudes, (b) computer anxiety, (c) computer self-efficacy, (d) self-report of computer confidence, and (e) computer coping strategies. While many of these characteristics have been studied alone or with other correlates (Bandalos & Benson, 1990; Delcourt & Kinzie, 1993, Hudiburg, 1996; McInerney, McInerney, & Sinclair, 1994, Violato, Marini, & Hunter, 1989), this particular constellation of individual characteristics is unique in the literature and represents a new, pedagogically-based framework of constructs.

Method

The fifty teacher candidates who participated in this research came from two sections of the same teacher preparation course. One section was reserved for elementary education majors and the other for those interested in teaching subject matter at the secondary level. The individual characteristics of preservice teachers associated

with levels of computer competence were measured at the beginning and end of this one-semester class in a pretest-posttest design. The instruments assessed the five sets of "changeable" individual characteristics and included four openly published instruments and three others that were newly developed for this study. About a week after the surveys were returned to the instructors, the data were analyzed and the scored surveys were given back to students and the group data for the class was presented during a class session. Students were asked to compare their individual scores on the surveys and to try and find where they fit in the distribution of class scores that were represented in the graphical displays of data. The instructors led class discussions that emphasized how the surveys could be used as tools for goal setting and reflection. Students generated ideas and talked about ways in which they could help themselves and their colleagues learn to use computers in teaching subject matter. During the semester, students also participated in hands-on technology activities and the surveys were readministered to students at the end of the semester. The results of the data from Time 1 and Time 2 were again shared with students in a brief class discussion.

Three different sources of data were used to investigate candidates' metacognitive awarenesses, experiences and strategies. At the completion of first survey administration, the class discussion, and the hands-on activities, students were asked to complete a "fast write" which is a one-page set of open-ended questions that can be completed in about five minutes. The majority of the fast write questions assessed metacognitive constructs. In addition, all 50 teacher candidates participated in short, semi-structured interviews and 7 of the students were selected for in-depth interviews as case studies.

Results

Results from the fast write data, brief interviews, and in-depth conversations revealed that the technology-based instructional activities provided many of the teacher candidates with metacognitive knowledge about themselves and others as well as initiated metacognitive experiences in a variety of contexts. Metacognitive experiences are described by Garner (1987) as awarenesses, realizations, or "ahas," and these experiences often flow from metacognitive knowledge. The three different methods of data collection provided different facets and layers of depth to the awarenesses and experiences that were the primary metacognitive constructs investigated in this study. Although evidence of metacognitive activity initiated by instructional opportunities is but one of the theorized components of self-regulated learning, it is a promising first step toward supporting the development of self-directed computer learning.

A selection of responses from the fast writes that were given after the survey completion activity, the class discussions, and the hands-on technology sessions indicate that these activities triggered metacognitive experiences and knowledge.

> I always knew that I would have to improve my technology skills to be able to integrate it into my teaching, but completing the survey helped me expand my horizons as to how much technology is really used. (Candidate #9, Survey)

> I learned that I am actually on the high end of attitudes and aptitudes, which surprised me. I like working with computers, but sometimes I feel overwhelmed. (#26, Discussion)

> I have been "surfing" the Internet for teaching ideas for some time. But we did find an idea which integrated "use" of the Internet in class with the students, which I have wanted to learn how to do. (#26, Hands-on)

> I plan on using the Internet for my lesson plans in my classes as well as ideas for my collaborating teacher's classroom when I have to teach again! (#39, Hands-on)

The short interviews given to all 50 students provided them with opportunities to describe metacognitive knowledge and experiences that occurred in contexts that included but were not limited to the activities tapped by the fast writes. For example, knowledge gained from the Computer Coping Strategies scale was instrumental in the computing experiences of a student who believed it changed the nature of her subsequent interactions with computers.

> I noticed that after taking the first questionnaire, I thought about the fact that I do use the help buttons or balloons more often. Sometimes I'll just pull the balloons out and say "Okay, let's run through the icons and figure out what things are in programs." I'm much more likely to open up new programs that are just on the hard drive and see what they are. Maybe it'll help me. So I've learned that those things are there, why don't I just use them? (#44)

> One student expressed an awareness that he was becoming less anxious as he continued to work with computers.

> I always feel like I'm always going to somehow break the computer if I type in the wrong command and I feel less and less like that now. I've learned to be more patient. Just realizing that other people are struggling with the same things through this class and my interaction with you. That's comforting and I don't panic as much because I realize that happens to even the experts. (#33)

The final source of data were the case studies of students who were systematically selected to represent diverse computing experiences. One of these students believed that the Technology Proficiency Self-Assessment that was developed for this study was particularly valuable, not only as a benchmark for initial computer competence, but also as an example of how technology could be used in the classroom.

The proficiency survey actually did a number of things for me. It showed me the things that I've been taking for granted that I was able to do with computers. It gave me a sounding board to see where I was situated in terms of the technology requirement. It provided ideas for how I can use technology as a teacher and as a teacher candidate and it showed me how much I still have to do. It definitely helped me pinpoint areas that I need more practice in and things that I would like to learn how to do. ("Jean")

Implications for Education

This research has enriched the field of education in two ways: (a) by developing a pedagogical approach that provides an immediate and adaptive application of research, and (b) by extending research on self-regulated learning to the domain of learning to teach with technology. As an innovative approach to teaching at the preservice level, this study opens the door for a new line of research that combines psychometric measurement and qualitative research methodology with the direct intent of application to educational goals for learning. Although the examples of metacognitive knowledge and experiences triggered by the technology-related activities presented in this paper are but a small selection of a much larger body of evidence, they clearly show that these activities were successful in their application. Ideally, more time would be allotted to class discussions, reflection, and hand-on instruction during the semester than the four total hours provided in this study. It is encouraging, however, to note the compelling evidence that students reported increased metacognitive knowledge, awarenesses, and experiences given these time constraints. Although metacognitive knowledge and experiences are components of the more comprehensive and long-term processes that support self-regulated and self-directed technology learning, this new teaching approach shows promise for successful elaboration and integration in multi-semester teacher preparation programs.

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S C I E N C E

Section Editors:
Jeffrey M. Kenton, *Iowa State University*
Polly Mumma, *Iowa State University*

This year, Science section for the SITE 98 Annual Meeting offers up twelve selections. These papers embody a changing perspective about the role of technology in science learning as well as teaching. Several authors report the use of Internet or other distance communications technologies. Other authors investigated the use of alternative lecture and learning styles.

Bodzin and Park report the use of an electronic community to help alleviate the feeling of isolation often felt by inservice teachers. Their research centered around the use of an email listserv to encourage discussion between distant teachers for the purpose of exchanging ideas, as well as to share solutions to common problems.

Coverdale describes a classroom environment wherein students are encouraged to integrate several forms of information gathering tools. This integration also may lead to integrated curriculums, activities which engage students in solving a problem by viewing it from various perspectives. Coverdale's example integrates the MECC Yukon Trail into several different classroom with help from the World Wide Web to investigate topics of student interest.

Eggebrecht and Dosch report on the development and intentions of the Smithsonian Secondary Science Network. This network was initiated in the state of Illinois to engage students in inquiry-based science programs. This emphasis on inquiry-based science learning is advocated by the National Research Council's National Science Education Standards.

Hemming and MacKinnon describe the effect notebook computers have on student learning. The focus of their research is the Acadia Advantage, a program implemented at Acadia University, Wolfville, Nova Scotia, Canada, which places notebook computers in the hands of all undergraduate students

Lehman, Rush, Buchanan and Averill report the findings of Project INSITE, instituted in the state of Indiana to help science teachers and preservice teachers augment their science literacy. Activities were hands-on and involved groups consisting of secondary science educators and preservice teachers engaged in a group-devised inquiry.

McDonald and Schultz investigated the effects of integrating technology into science methods courses at Nebraska Wesleyan University. Students enroled in these courses were expected to use technology as a method of communicating between groups, gathering information, and disseminating results.

McGee reported the results of an on-line master's degree program at the University of Texas-Brownville. Students enrolled in the program were thus able to register for classes at UT-B and attend classes elsewhere, if necessary. Respondents indicated that the on-line program gave students more control over their own learning.

Orlik investigated the integration of technology into traditional, lecture-based instruction, as well as suggesting new methods for integrating educational technology into laboratory courses.

Rezaei and Katz investigated the use of educational technology in instructional design and curriculum development. Rezaei and Katz introduce a three phase program to implement educational technology teaching and learning environments.

Van den Berg discussed the development of an on-line, World Wide Web based science interactive system. The prototype of this system operates within a larger framework called MUST (Multimedia in Science and Technology). Users were able to gain insight into the teaching and learning styles displayed on the WWW pages, as well as view QuickTime movies of actual classroom experiences.

Winslow and Smith reported the use of an on-line teacher mentoring program in use at Coastal Carolina University. Users are able to communicate their questions or solutions in a World Wide Web-style chat environment.

Yaffe discussed the development of combined learning, training and support environments at the Open University of Israel. The environments are based upon TAMID, which is an Hebrew acronym representing Communications, Science, Knowledge and Teaching.

These papers indicate the state of technology and science education in the United States as well as from other areas around the world. Enjoy reading them.

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The Effects of Preservice Science Teachers Engaging In An Electronic Community

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Teaching has been characterized as a culture of isolation (Schlagel, Trathen, & Blanton, 1996). A practicing teacher does not usually have access to ongoing development and support in their classroom setting which promotes idea sharing or support from peers. Electronic communities for teachers have the potential to break down these teacher isolation barriers and provide a support network for teachers in the classroom (Bull, Harris, Lloyd & Short, 1989; Casey, 1997). New science reform platforms, such as the National Science Education Standards, recommend including educational technology, especially telecommunications, in K-12 classrooms. Teachers now have opportunities to join on-line discussion groups on the World Wide Web, post questions to electronic bulletin boards, and communicate thoughts and ideas using an e-mail listserv. Many studies describe how teachers learn about telecommunications technology, the kind of support required for teachers to implement such tools effectively, and the obstacles that teachers must overcome in order to successfully incorporate them into their daily practice (Bos, Krajcik, & Patrick, 1995; Caggiano, Audet & Abegg, 1995; Casey, 1994; Casey & Vogt, 1994; Russett, 1994; Russett, 1995; Sunal & Sunal, 1992; Weir, 1992).

Background

Some studies have been conducted on the effects of preservice teachers interacting with an electronic telecommunications network. The Curry School of Education at the University of Virginia created the Teacher-LINK system in 1984 to study the process of establishing a network to support the student teaching process (Bull, Harris, Lloyd & Short, 1989). This study reported that preservice teachers used Teacher-LINK as a communications link to their university instructors during their field experiences using electronic mail (e-mail) and as an electronic conferencing system. Merseth's (1992) study on first-year teachers participating in the Beginning Teacher Computer Network (BTCN) showed that first year teachers used electronic telecommunications for personal, emotional, and technical support. Casey's (1994) study on preservice teachers using TeacherNet at California State University reported the following benefits of preservice teachers using a telecommunications network: increased time to reflect on what they were learning; increased feeling of rapport with and support from their university supervisor; decreased feeling of isolation; increased self-esteem due to mastering technology; and increased knowledge and use of information access and retrieval. The preservice teachers in Waugh and Rath's (1995) study perceived that networks can enhance teacher training and support their work in the schools by using them to access resources and communicate with others. Waugh's (1996) study on group interactions and students' questioning patterns in a university course using an electronic network showed that students posted questions predominantly concerned with technical aspects and network strategies more than personal questions. An exploratory investigation of preservice English teachers using telecommunications during their methods instruction and student teaching reported that electronic mail was an asset for meeting course requirements and maintaining contact between students and instructors (Thomas, Clift & Sugimoto, 1996). The results of a study by Schlagel, Trathen and Blanton (1996) at Appalachian State University point to the structure of e-mail use as being an important factor in eliciting spontaneous exchanges of ideas.

The SciTeach Forum

In order to examine the potential benefits of preservice science teachers engaging in an electronic professional community for science teachers on the World Wide Web, we have constructed a "Web Forum" called the SciTeach forum. The SciTeach forum is a place where science teachers can share ideas, reflections and conversations on teaching and implementation of technology in the classroom and other instructional pedagogy, while also providing support for other members of an electronic professional community. The SciTeach forum is designed with NetForum software. Netforum is a Web based group communication and collaboration system provided by the

University of Wisconsin Biomedical Computing Group. The program is written in Perl and works on any UNIX-based system with Perl 4.0.1.8 or later that supports CGI subdirectories. Forums are organized into discussion topics and messages. A simple, intuitive toolbar allows user access to NetForum features. Forums can be created and managed by "forum owners" with the administrative tools via the World Wide Web. Forum topics and messages can also be edited via the administrative tools. Forum owners can customize many forum features and can add HTML codes into the headers and footers of each of the forum's web pages.

We selected the Netforum software to create the SciTeach forum because it was available to us at no monetary cost; North Carolina State University has a site license to use the software. The software is easy to use. The software empowered us to structure the discussion topics on the forum in any order of our choosing. The software also enables any user to add a new discussion topic to the forum. Within each topic area a user can post a new message, reply to a message, or reply to a reply of a message. When users first enters a topic area, they are presented with a list of message and reply titles. Each message and reply title displays the author of the message and the date the message was posted on to the forum. The most recent message is listed at the top of the screen. Each message and reply title is a hypertext link. The user clicks on a message or reply title to view the posted message. The software also enables the user to read an entire thread of successive replies to the original message.

The SciTeach forum can be accessed by anyone with a connection to the World Wide Web. A special e-mail account is not a requirement to read forum messages or post messages on to the forum. Unlike many other studies involving preservice teachers using telecommunications during their student teaching semester, we did not have additional funding to equip our preservice science teachers with laptop computers and telephone modems. We assumed that at least one computer in the school where a student teacher was placed would have access to the World Wide Web.

We structured the SciTeach forum to contain discussion topics relating to teaching science content, incorporating instructional technology into the curriculum, and topics relating to teaching pedagogy in general. A special topic in the SciTeach forum called "Preservice Science Teachers" was created as a designated discussion area for preservice science teachers. Student teachers are encouraged to use this area to speak freely about their experiences. Initially, the following topic areas were placed on the SciTeach forum:

- IMSE CD-ROM
- CD-ROMs for Science
- Classroom Management Strategies
- Computer Assisted Instruction (CAI) and tutorial software
- Data Collection and Analysis Tools
- Data Sets from the World Wide Web
- Demonstrations
- HyperStudio/HyperCard
- Instructional Laboratories
- Laserdisks and video
- Portfolios - development and evaluation
- Research in Science Education
- Science Fair project ideas
- Science Software Simulations
- Search engines on the World Wide Web
- Sounds of Science
- Telecommunications in the classroom
- Video conferencing/CU SEE-ME in the science classroom
- Web site reviews and evaluations

Pre-Service Science Teachers

Four more discussion topics were later added to the SciTeach forum by our preservice teachers during their student teaching semester. These topics were:

- Science House
- Working with Special Students
- Learning and Teaching Models
- Assessment Strategies

Two other topics were later added by university instructors (one from another institution other than North Carolina State University). These topics were:

- Quick Help
- Staff Development Opportunities

The SciTeach forum is placed in the context of a larger web site on the World Wide Web called IMSEnet (online available at http://www.ncsu.edu/imse). IMSEnet is a "Network of Instructional Materials for Science Educators" which was created originally as a support network for the IMSE (Instructional Materials in Science Education) CD-ROM.

The preservice science teachers were introduced to the SciTeach forum during the second day of their Instructional Materials in Science Education course at North Carolina State University. This course met each day for the first five weeks of the student teaching semester. The students began their student teaching placements during the sixth week of the semester. Each student was instructed to use the forum in class and was required to post a message on to the forum which introduced themselves. As part of the course work for their instructional materials course, all students were required to post three messages per week to the SciTeach forum.

Exploratory questions:

1. How did our preservice teachers use the IMSEnet web-forum during their student teaching semester?
2. Does the SciTeach forum serve as an effective means of support for a cohort group of preservice science teachers?
3. What are the benefits of having preservice science teachers interact with an electronic professional community?

The remainder of this paper will show an examples of the how preservice teachers at North Carolina State University have used the SciTeach forum during their student teaching semester and discuss what types of messages our preservice teachers have been posting on the forum.

An example from the SciTeach forum

The following example comes from an exchange in the "Classroom Management Strategies" discussion topic section. Miranda had discipline problems with a particular class. She posted a message to the forum which described problems with students behaviors she encountered, her attempts at resolving these problems, and a request for assistance.

Kirk had a similar experience with a class during his student teaching semester and used the forum to share some strategies he found useful in solving some of the student behavior problems he encountered.

Wanda also had a similar experience and offered Miranda a suggestion based on her prior experience.

Jack reflected on what was said in the previous thread of messages and concluded that the problem lay with current pedagogical philosophies.

Such exchanges on the SciTeach forum between Miranda and her classmates enabled her to share an experience with her classmates. The content of Miranda's original message dealt specifically with teaching pedagogy. She used the SciTeach forum as a way to express tension she was experiencing during her student teaching. She used the forum to request assistance for her problem. The replies to Miranda's original message showed solidarity among the preservice science teachers. They were each experiencing a similar problem and used the forum as a mechanism to support each other. By using the forum, preservice science teachers were able to discuss problems and contribute ideas over extended periods of time. By engaging in this type of dialogue exchange, the SciTeach forum appeared to serve as an effective means of socio-emotional support for a cohort group of preservice science teachers.

Other kinds of messages

The SciTeach forum has been a useful tool to facilitate communication between our preservice science teachers and university instructors. The forum has been used by our preservice science teachers to express their concerns about course requirements. Many messages have been posted regarding specific course-related queries and housekeeping bulletins. The SciTeach forum has also been used by the preservice teachers to critically reflect on the meaning of being a teacher:

Conclusions

There appear to be many benefits of having preservice science teachers engage in an electronic community. The forum provides a means for sharing and discussing common experiences over geographical distances. The forum provides a way for preservice teachers to receive help and support for the problems and tensions they experience during their student teaching experiences. The forum also serves to facilitate communication channels between the student teachers and their university instructors. The open structure of the SciTeach forum appears to be an important factor in the free exchange of ideas, questions, and other types of dialogue among preservice science teachers. Preservice science teachers used the SciTeach forum to post questions pertaining to pedagogical issues and personal issues. The forum was also used to exchange professional information such as teaching strategies and curricular material.

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PREPARING PRESERVICE ELEMENTARY TEACHERS TO INTEGRATE INSTRUCTIONAL TECHNOLOGY INTO THE SCIENCE CURRICULUM

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My office bookcase contains hundreds of science education books and technology journals. In preparation for my elementary science methods course, I recently re-read sections of Carl Sagan's (1996) book *Science as a Candle in the Dark: The Demon-Haunted World*. In this book, Sagan describes the evolution of stone age technology and playfully suggests the probability of an apprenticeship system on the East African savanna established to propagate the long-term production of stone tools. After re-reading Sagan, I turned my attention to a selection of current articles on science and technology education that describe how today's students and teachers utilize instructional technology to meet educational goals. This juxtaposition of views on technology strikingly indicates how far civilization has come in its use of technology as a tool in everyday life.

Even though research on technology's effectiveness in promoting better learning is still in its infancy (Trotter, 1997; Kay, 1997), technology in the work and school environments is rapidly increasing. In his book *The Road Ahead*, Bill Gates (1996) argues that even though the information technology of most K-12 schools is far from state-of-the-art, America's continued investment in technology will "empower people of all ages, both inside and outside the classroom, to learn more easily, enjoyable, and successfully than ever before" (p. 208). Gates (1996) metaphorically describes schools' ever-increasing use of the Internet and other technologies as a "Gold Rush" (p. 260).

Those involved in teacher preparation or work with K-12 schools know that the Gold Rush towards technology use is on, and its effectiveness in the classroom looks promising. Mann and Shafer (1997) report that America's huge technology investment in schools is paying off in better student achievement. Although in 1996 only 14 percent of America's K-12 classrooms were wired for Internet use, and even though access to technology remains an issue (Trotter, 1997), technology continues to be seen as central to school reform.

Teacher preparation programs need to integrate the use of instructional technology into methods courses and field experiences (Brownell, 1997). While most k-12 schools in America provide some form of technology instruction to students, many graduates of teacher preparation programs are not adequately prepared to utilize technology once they become teachers (Brownell, 1997). Thus, one of the primary issues related to schools' use of technology is the preparation of teachers to use it. Most teachers are willing to learn how to integrate technology into their curriculum if given sufficient training and administrative support (Wallinger, 1997; Mann & Shafer, 1997; Zehr, 1997). While inservice staff development in technology integration will be ongoing, the initial preparation of technologically literate preservice teachers is critical in order for K-12 schools to develop and implement successful technology initiatives. In this paper, I describe an elementary science methods course designed to prepare preservice teachers to utilize instructional technology in teaching science, and to develop an initial phase of technological literacy.

Theoretical Framework

The literature on instructional technology is abundant, despite its relatively recent emergence in K-12 schools. Fulton (1993), Viau (1994), David (1990), Cuban (1993) Grejda & Smith (1994) and others offer definitions and rationales for technological literacy and its role in K-12 education. Because of the recent emergence and rapid expansion of various forms of instructional technology, many in academe link the implementation of instructional technology across the disciplines to the process of school reform. In other words, widespread use of instructional technology in K-12 schools is not the traditional paradigm.

In promoting instructional technology as a means of restructuring schools and curricula, David (1990), Collins (1990), and Sheingold (1990) optimistically described technology's potential for contributing to the systemic reform of schools. In order best to match the technological society students live in with appropriate curriculum experiences in school, instructional technology must become not just available, but indispensable to the process of teaching and learning. Dwyer et al. (1990) and David

(1990) concluded that teaching and learning must fundamentally change from the traditional paradigm to one that embraces the implementation of instructional technology across the curriculum.

The current literature is replete with studies and examples of how preservice teachers are being prepared to utilize technology and how inservice teachers are currently integrating technology into their curricula (Lonergan, 1997; Davis, 1997; Hancock, 1997; Zhang, 1997; Powers, 1997). While these teachers and others are focusing on innovative ways of using technology, as stated previously, technology integration is not the traditional paradigm. Thus, schools and colleges of education are being mandated to do better in preparing preservice teachers vis-a-vis technological literacy.

In its new report, *Technology and the New Professional Teacher: Preparing for the 21st Century Classroom*, the National Council for Accreditation of Teacher Education (NCATE) argues that teacher education programs are not adequately preparing tomorrow's teachers to enter the workforce technologically literate. The report acknowledges that "re-educating the existing teaching force will not be easy and will require extensive professional development over many years" (p. 5). The report also argues that it is critical for colleges of education to create a vision and develop a curricular plan that will facilitate transforming the culture of teacher education in a way that situates technology centrally in the teaching and learning process (NCATE, 1997). The report provides several case illustrations that epitomize current and future NCATE accreditation requirements.

Course Structure

In piloting a science education methods course for elementary teachers (Educ 426), instruction focused on the integration of technology into the curriculum. In designing the course, course goals were established that were consistent with the *National Science Education Standards* (NRC, 1996) and the *Benchmarks for Science Literacy* (AAAS, 1993). Thus, the course was designed to help students develop scientific and technological literacy.

With these literacies in mind, and with the resources available, four technology projects were incorporated into the course. Meeting four hours per week, students worked on the following technology projects:

1. Participation in a nationwide listserv for preservice teachers taking science methods courses;
2. Participation in a "telecommunity," in which students utilized email to communicate with the instructor, each other, and other preservice students about science-related issues;
3. Utilizing the World Wide Web to explore science curricula and Internet-based science projects; and
4. Participation in an Internet-based technology project called MayaQuest.

Description of the Technology Projects

A pre-test given on the first day of class indicated that even though students had fulfilled their liberal arts science requirement, they had little conceptual understanding of scientific or technological literacy as delineated by national reform documents. Answers on the test also indicated that students' use of technology was limited to occasional email use and using word processing to prepare papers. None were using the Internet as a research tool for their coursework. Thus, while developing technological literacy was a course goal, the purpose of the technology projects was to *introduce* students to using technology as a curriculum design tool.

The Elementary Science Methods Students Listserv

The elementary science methods students listserv and a similar listserv for faculty was established in February, 1997 by Professor Emily H. van Zee at the University of Maryland. Approximately three hundred elementary science methods students actively participated in the listserv. Students enrolled in Educ 426 were required to review the daily messages, and reply to a minimum of one message per week. Students' replies were also forwarded to each of their own class members and myself. Students indicated that the listserv conversations were useful, but participation in the listserv was very time consuming.

EDUC 260 Telecommunity

The primary purpose of the telecommunity was to model the process of accessing and sharing information electronically, an important aspect of technology use in elementary classrooms. A Notes Conference was established so that class members could communicate with each other, the instructor, and global peers on technology issues, particularly issues pertaining to curriculum design and classroom management. Students also completed weekly assignments and submitted reflective journals directly to the instructor via email. Thus, the instructor was able to communicate via email with students collectively, and individually.

Utilizing the World Wide Web

Current rhetoric in education journals seems to assume that the information superhighway is jammed with students and teachers trying to use it. Educ 426 students, however, had only a "general sense" of what the World Wide Web was and did not know how to begin using it. To prepare them, we first read WestEd's book *Tales From the Electronic Frontier*, which provides several cases of exemplary technology use in K-12 mathematics and science classrooms. Next, the instructor provided the class with a list of science-related web sites and students spent one two-hour session in the computer lab exploring web sites and learning techniques of web site navigation. The instructor

made short assignments that required students to utilize the web in problem-solving exercises. Finally, students developed and taught a two-lesson unit that utilized the World Wide Web in age-appropriate activities (see MayaQuest below).

MayaQuest '97: Lost Cities of the Rainforest

Students participated in MayaQuest because it was an interdisciplinary, interactive, Internet-based project lasting approximately one month. Students were able to follow the daily progress of an actual team of scientists as they bicycled through the Yucatan Peninsula, studying the rainforest and Mayan culture. The MayaQuest curriculum guide is thorough, and is cross-referenced to the *National Science Education Standards*. After participating in MayaQuest, students worked in pairs to develop and teach a two-lesson unit related to Mayan culture.

Discussion

Participation in the listserv was time consuming and labor-intensive. The instructor monitored the listserv messages carefully, and downloaded different types of messages daily. On one hand, students were stressed at the management issues related to this project because they received 15-20 email messages per day. Students were not accustomed to such heavy email traffic, and the process of reviewing, sorting, deleting, and saving messages created time pressure on their personal schedules. Also, students had to be careful about message management because they were required to respond to at least one message per week. On the other hand, students felt the listserv participation was valuable for two reasons: a) they learned that students across the country were struggling with similar issues while they were learning to teach elementary science; and b) they were able to obtain many valuable ideas about science resources, and tips on teaching specific topics at specific grade levels.

A pattern of messages was prevalent through the first few weeks of listserv participation. Messages were very short, solicitating assistance in gathering resources on specific topics. While messages seeking curricular assistance initially dominated the listserv, students' replies became more lengthy and sophisticated, often explaining in detail *how* resources might be used, classroom management strategies, appropriate web sites to explore, and pedagogical suggestions.

The Telecommunity and the World Wide Web

To document the outcome of the technology projects, students compiled a "technology notebook" which included samples of work from all four technology projects. Participation in the telecommunity contributed to a large section in the notebook as students included their reflective journals and instructor responses, messages sent and received on the listserv, email messages and information from MayaQuest, class email discussions, and annotations on useful web sites. The instructor used the telecommunity project to make assignments that pushed students' use of the World Wide Web in problem-solving activities. Students enjoyed the inductive process of exploring web sites, and spent a lot of time on education-related sites such as:

- www.gsn.org (The Global SchoolNet);
- www.usgs.gov/education (U.S. Geological Survey, The Learning Web);
- www.learner.org/k12 (The Journey North Project).

Students became very comfortable in using the WWW to research science topics, and shared annotated bibliographies of web sites with class members as part of the telecommunity project. Much class discussion focused on the *quality* of web sites and their relevance to curriculum design.

MayaQuest

The MayaQuest project and web site was very rich in terms of its interdisciplinary content and its built-in interactivity. Students were not familiar with Internet-based projects and enjoyed monitoring the project and communicating with students and teachers throughout the United States. Students indicated that the interactive nature of MayaQuest was the most interesting and useful feature of the project. Students were required to send and respond to a minimum of one MayaQuest email message per week to learn more about the team's scientific research and how others were using the project in their classrooms.

While students enjoyed participating in MayaQuest, they did express frustration due to access problems. They were often unable to access the web site during the day due to the hundreds, perhaps thousands of "hits" on the site during K-12 school hours. This difficulty however, provided a "teachable moment" because this was an authentic issue related to Internet-based projects.

Conclusion

The NCATE standards for technology clearly delineate what teacher preparation programs need to do to prepare technologically literate preservice teachers and maintain program accreditation. Fisher (1997) and Brownell (1997) make a strong case for technology competency in today's preservice teachers. What is indicated in the literature is that there are a variety of models beginning to emerge in teacher preparation programs that require preparation in technology integration. In Educ 426, the students entered technologically illiterate in terms of using technology as a curricular design tool. Thus, my goal was to introduce students to a variety of technological tools to enhance thinking about teaching and learning in the elementary science classroom.

In post-course interviews with several class members, several themes emerged vis-a-vis students' preparedness to utilize technology in their teaching. Prior to the course, students showed a lack of confidence in their ability to utilize technology and were overwhelmed at the thought of participating in the four technology projects. After completing the course, the same students described the motivational aspects of their own use of technology, their own transformations in seeing the power of technology in curriculum design, and the importance of utilizing technology to access and share information in classroom settings. In describing the benefits of using various technologies in teaching elementary science, one student stated:

> Going into it, I didn't know a lot about it. I was kind of scared of it. Going into this class, I was extremely nervous about it and remember the first day you talked about how everything was going to be over email and the listserv and we were going to do technology projects on the web. I had a hard time that day because I knew I didn't know how to do it.
>
> And now, I enjoy it, I like it. I have found so many neat projects for children on the web that would make a good classroom much more interesting. This has been a tremendous help and I'm hoping that I will have the Internet in my classroom so that I will be able to use it.

Another student responded:

> Before taking this class, neither Tracy or [sic] I would've been able to sit down and talk about technology the way we have been...

This anecdotal evidence of the utility of technology integration into science methods courses is consistent with research cited in this paper, and with the vision and standards provided in the new NCATE report on technology in teacher preparation programs. The purpose for developing technological literacy in preservice teachers goes beyond developing competency; it speaks to preparing novice teacher who view teaching and learning in new ways. Technologically literate teachers should "help students pursue their own inquiries, making use of technologies to find, organize, and interpret information, and to become reflective and critical about information quality and sources" (NCATE, 1997 p.4).

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The Smithsonian Secondary Science Network

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A professional development network of science teachers, the Smithsonian Secondary Science Network, is working toward the transformation of teaching and learning in secondary schools in Illinois. The goal is to change teachers' beliefs and practices in order to engage all students in an inquiry-based science program aligned with the *National Science Education Standards* (1996) developed by the National Research Council.

The Network is a coalition of school-based teams composed of teachers with administrative support. The professional development activities of Network participants are aimed at the creation of an integrated science program in each of their schools. Each of these teams develops their own contexts for learning which we call problem platforms. Each of these programs are different, reflecting the interests and talents of the teachers and learners involved and the resources of the school. Some teams begin with the immediate development of full year, or multiple year, courses. Other teams develop their program more slowly with short, two or three week, projects.

The Network is currently composed of twenty schools in urban, suburban, and rural communities and involves approximately sixty teachers. A website documents and supports the work of network. Currently, curriculum materials used at the Illinois Mathematics and Science Academy (IMSA) - which provide the equivalent of three year-long courses in introductory science - are distributed from their webpage and each local implementation of the program is described as well (Dosch, Eggebrecht & Styer, 1997).

Recently, bulletin board and chat room utilities have been added to the website. These are intended to provide convenient and uncluttered communication among participants and with public and private clients whose support is required for success. The expectation is that these resources will extend the conversation beyond the level found at traditional large group meetings and site visits. However, participating teachers, and secondary school teachers in general, are suffering from "task saturation." Although Network activities will encourage use, the real value to teachers will determine whether electronic collaboration will follow an historical trend (Anderson, 1993). While participants have access to the Internet in their schools, most rarely use either e-mail or bulletin boards. Network teachers frequently comment on the benefits of their collaborations which cross discpline and district boundaries. The question to be answered is whether they will regard electronic collaboration as authentic.

Illinois Science Education Policy Changes

On July 25, 1997, the Illinois K-12 Learning Standards were approved by the Illinois State Board of Education. The *National Science Education Standards* provided the model for the science component. Illinois public school students soon will be required to receive instruction in three areas: Content (Biology, Chemistry, Earth and Space Sciences, and Physics); Context (social and personal issues in science and the nature of science); and Process (inquiry and technological design).

While these new standards present a serious challenge at all levels, the challenge is particularly great at the high school level. Illinois School Code requires a minimum of one year of secondary science instruction; most secondary schools in the state require only two years of science instruction. And, like nearly all secondary schools throughout the nation, instruction is dominated by coverage of content with little or no attention to societal context, the history and philosophy of science, inquiry, or synthesis (Tobin & Gallagher, 1987). The new standards will anchor the revised state assessment which has traditionally played a driving role in the design of classroom activities.

Many other states recently have adopted new standards for science. Educational policy envisioned by *Science for All Americans* is being crafted (American Association for the Advancement of Science, 1989). Will these changes in policy be reflected by changes in the classroom? Prior experience suggests not (Cuban, 1990; Elmore, 1996); not without a reconceptualization of teaching and system-wide support which permits and sustains it (Knapp, 1997).

Reciprocity: Teachers as Learners

Michael Fullan wrote that educational change depends on what teachers do and think (Fullan, 1991). NSF-sponsored science curriculum materials projects, and the

professional development efforts to train teachers to use these, have had limited success in changing teaching practice. We have erred in assuming that good ideas would diffuse into U.S. classrooms and schools. Teachers' beliefs about the value of the behavioral changes intended by these curricula strongly affected their ability to adopt the materials as they were intended; to support the learning of science by engaging students in the process of science. While research indicates that inquiry-based learning experiences in science classrooms have a positive effect on student performance (Shymansky, Kyle & Alport, 1983; Wise & Okey, 1983), they are rarely practiced (Stake & Easley, 1978; Tobin & Gallagher, 1987; Yager, 1992; Yager & Lutz, 1994).The dominant mode of classroom instruction continues to be that of the transmission of information (Elmore, 1996; Goodlad, 1984; Tobin & Gallagher, 1987).

Teachers' personal experiences as students typically did not involve research, and as such, their models are those instructional practices which emphasize conclusions (Schwab, 1966; Talbert & McLaughlin, 1993). Reliance on the lecture places great importance on classroom management; silence implies attention and student-student interactions are distractions (Tobin, Espinet, Byrd & Adams, 1988). When attempts are made to incorporate inquiry-based instruction, conflict with beliefs in the importance of correct-answers, quiet classrooms, and coverage bring a return to the didactic approach (Brooks, 1983).

There is a reciprocal relationship between theories of student learning and theories of teacher learning. Both students and teachers have naive ideas about the nature of learning borne of years of classroom experience (McRobbie & Tobin, 1995) and enforced by preservice(McDermott, 1990; Schon, 1987). Teachers' and students' learning experiences which involve procedural tasks and are not intellectually demanding and involve little risk may not lead to durable knowledge (Doyle, 1983). This is the compromise about which Sizer (1984) wrote and is reinforced by typical in-service models of professional development (Burke, 1994). Teachers, as well as students, are capable of inquiry and the experiences of both can be designed to produce conceptual change (McCombs, 1992).

The need for constructivist learning experiences in professional development activities is advocated in the *National Science Education Standards* for Professional Development and in the recommendations made by those who are leading the creation of a new vision of professional development (Darling-Hammond, 1994; Darling-Hammond & McLaughlin, 1995; Lieberman, 1995; Lieberman & Miller, 1990; Szabo, 1996). In particular, the traditional role of teachers as recipients and teacher-educators or consultants as deliverers of professional development experiences is artificial and counter-productive. Instead, teacher-directed inquiry and collaborative reflective practice are advocated.

The traditional conception of professional development as training for the acquisition of new skills or in the delivery of new curriculum should be replaced by an active process of personal, intellectual growth.

The most effective professional development (greatest impact and most sustainable) occurs in the context of the teachers' school, not another setting.

These guidelines have been implemented by the Smithsonian Secondary Science Network. Participants construct programs for their own schools and evaluate these programs using action research. They communicate the results of their work, serving as resources for each other.

Integrated Science as a Tool for Change Agents

Only 17% of women and 25% of men are given the opportunity to encounter physics in the high school classroom (Nelson, Weiss & Capper, 1990)One approach, which the Chicago Public School system is considering, is to extend the secondary science requirement to three years. While qualified science teachers are in short supply, particularly in physics, programs intended to recruit qualified, uncertified science teachers are in place. However, to meet the Illinois K-12 Learning Standards through traditional, disciplinary courses could require a fourth year of science. An alternative approach, which we have adopted (Eggebrecht, Dagenais, Dosch, Merczak, Park, Styer & Workman, 1996) is to to compress introductory secondary science into an integrated science program by applying the *NSES* content standards. Unlike content standards recently developed for other disciplines, the *NSES* can serve science education by deflating bloated curriculums that include superficial encounters into a sufficiently small set of essential concepts and skills that can be more deeply understood. Furthermore, integration eliminates the redundancy of repeated coverage without increased depth encountered in the traditional sequence. It is expected that each participating school system in the Network will implement their own version of this program while at the same time maintaining alignment with the *NSES* content standards.

According to the National Science Teachers Association (1996) integrated science curriculums are superior to single science discipline curriculums in several ways. These are: science disciplines are more strongly interrelated; topics are taught in a manner compatible with the student's stage of intellectual development; complex ideas are treated repeatedly over the years, each time at a higher level of sophistication; and students have opportunities to influence what topics they study and how they are studied. We also find the following reasons for this approach to be

compelling for their potentially beneficial effects on teaching practice.

Meeting new content standards requires change

Currently, most students terminate science after 10th or 11th grade. It is highly improbable that in the near future all students will complete four years of secondary school science in which they encounter the four disciplines of physics, chemistry, biology, and Earth and space science. Developing one or two year experiences that include all of these without fragmentation will require collaboration between subject-matter departments.

Teachers are isolated

Collaboration between teachers in different departments diminishes teacher isolation (Siskin, 1995) and allows an examination of habits which disciplinary alliances tend to enforce (Little, 1990). Our experiences, (Eggebrecht et al.,1996) and those of the teachers with whom we work, are that deeper understanding of, and appreciation for, a discipline are generated by these collaborations.

Students and teachers integrate their experiences

Useful knowledge is best developed by learning in multiple contexts (Anderson, 1993; Ceci & Ruiz, 1994; Gick & Holyoak, 1987). Students see instances in which learning has relevance beyond preparation for the next topic. A renewed enthusiasm for concepts which have become stale emerges when connections beyond the teacher's discipline boundary are uncovered.

The use of time and individualization are key elements of reform

Though schools are constantly changing in marginal ways in response to frequent policy changes, the core remains through regularities in the rhythm of periods, departmental relationships, and well defined responsibilities (Sizer, 1992). The integration of science instruction can interrupt this pattern in a way which is both sufficiently demanding and achievable (Eggebrecht et al., 1996).

Network Characteristics and the Role of the Internet

The creation of these integrated science programs is the joint work of a professional development network which began as curriculum development project sponsored by the Smithsonian Institution and the Illinois Mathematics and Science Academy. The project began five years ago with three teachers and thirty-five students. It has grown to approximately sixty teachers in twenty schools located throughout Illinois. As the Network has grown it has become more difficult to sustain our joint work through the conventional methods of large meetings, site visits, and summer work sessions. We are hoping to extend the conversation electronically. The presumed role of this medium embeds assumptions whose validity will eventually be assessed.

The Network supports the work of these teams in conventional ways: meetings of all participants in which work-in-progress is communicated, site visits by participants from other schools, and a year-end symposium in which the work of the Network is communicated to a larger audience. Participating teachers confront the usual challenges of conventional high schools: they teach five or six classes each day involving between 100 and 200 students, they have little or no time for preparation for these classes or to give attention to individual students, they are frequently required to implement decisions for which they have no ownership, student absences are high, and motivation to learn is low.

To participate in the large group meetings of the Network teachers must give up class time and devote additional time to preparing materials for a substitute teacher. There is very rarely time during the day for professional growth. The work day is devoted to maintenance and the professional development activities of the Network are relegated to evenings and weekends.

Given these pressures for time, we believe that the Internet may be used to significantly diminish the burden and increase participating teachers' enjoyment. Electronic bulletin board fora can extend this communication beyond the large group meetings and site visits, perhaps even partially replacing them. Curriculum materials which encourage cooperative, inquiry-based learning are distributed on the Internet in a form that can easily be modified in the time available for classroom preparation. When democratic classrooms and non-traditional curricula are attempted, political confrontations eventually occur. Chat room conversations including state and national level policy makers and leaders in science education reform can provide participating teachers and their local clients access to authoritative voices.

Curriculum Resources

Introduction of inquiry-based curriculum materials without teachers' reconceptualization of their roles may not succeed. While some teachers bring a wide variety of curriculum materials to a learning experience, textbooks are used by 90% of secondary science teachers and these traditionally drive the classroom work (Tobin & Gallagher, 1987; Weiss, 1977; Weiss, 1987). In many ways, the design and use of science textbooks mirrors the current structure and function of schools. It is difficult to imagine sustainable change while maintaining a strategy for classroom management rather than improved learning (Tobin, Tippins & Gallard, 1994).

Two important elements of the school culture have contributed to this reliance on textbooks: teachers have little time to prepare and the medium for distributing text materials makes the modification of available curriculum resources time consuming. A significant impact on educational practice has been derived from word processors

and web browsers (Ehrmann, 1997).These tools are fundamentally changing the nature of curriculum resources. Curriculum resources which are available electronically in a modifiable form make it more feasible for teachers with little or no preparation time to engage in reflective practice. It is likely that textbooks of the future will be of this form.

Science curriculum resources which are the product of ten years of writing by teachers at IMSA, many of whom once were practicing scientists, are distributed from the Smithsonian Secondary Science Network website. These may be downloaded, at no cost, in a form which can be edited with any word processor, independent of platform. We do not intend to produce a textbook. This would serve to reinforce rather than transform current teaching practice. These resources are adaptive; they can be resequenced to respond to alternative contexts and student inquiries. Also, curriculum materials written by teachers at other schools who participate in the Smithsonian Secondary Science Network will be distributed in this form. Over time we will have a set of curriculum resources which can support an integrative approach to high school science and span the broad spectrum of student characteristics and institutional resources.

Extending the Conversation

Electronic network support through bulletin board and chat room has only recently been added to our website, so the usefulness of these to Network participants is yet to be determined. For our implementation of these features we have chosen softwarewhich is designed to support courses on the Internet (Goldberg & Salari, 1997). This approach allows the bulletin board and chat room to be accessed by passwords. This should eliminate some of the superficial comments which clog bulletin boards. It also protects the privacy of postings in a psuedo-professional climate where retaliation is common.

Our experiences with bulletin boards suggest that an incubation period is required. Bulletin boards seem to acquire a personality which some find sufficiently engaging to overcome the impersonal nature of a typed comment, however informally it is presented. . We are planning to inoculate the culture by requesting summaries of work-in-progress as bulletin board postings and by scheduling chats to discuss this work.

Status Light

Educational reforms through the century have produced isolated pockets of transformed practice but they do not represent larger reforms (Elmore, 1996; National Commission on Teaching and America's Future, 1996). In the Smithsonian Secondary Science Network our strategy is to transform the culture of the secondary school science classroom by drawing both students and teachers away from the comfort of the passive exchange of a static, fragmented science. Instructors in the IMSA Integrated Science program work with other high schools throughout the State to transform secondary school science education from the teacher-directed, study of science as unambiguous, disconnected and unmysterious facts to student-directed, scientific inquiry aimed at the resolution of meaningful, and realistically complex, problems.

Our goal is the transformation of secondary science education and a fully integrated science program for students which reflects the national standards for content, practice and assessment. Based on the success of our network thus far, the interest it has generated among teachers and administrators throughout the State, policy changes in Illinois, and the Illinois Transformation Initiative there are some reasons to believe that this goal can be achieved.

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"The Acadia Advantage": Notebook Computers and Teacher Education

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A unique teaching and research setting exists at Acadia University for investigating the impact of computer-based technology on teaching and learning. With IBM corporate support, Acadia represents the first university in Canada to venture into a campus-wide laptop project, through an initiative called "The Acadia Advantage". The intent of this on-going project is to integrate the use of notebook computers into the undergraduate curriculum. All first-year Bachelor Degree students (1997), lease a Pentium laptop computer from the university. A major rewiring of the campus allows for 1400 students and 170 faculty to have computer network access on and off campus. In addition, the university provides on-going faculty professional development in order that faculty might meet the challenge of pedagogically-sound use of computers in the classroom.

In the Bachelor of Education program, all faculty teaching first year students exercise a variety of strategies to integrate the use of computer-based technology into their courses. This paper examines four computer-based teaching and learning strategies used during the first year of The Acadia Advantage project in the curriculum areas of Language Arts Education and Science Education. The instructors in both courses were interested in using teaching strategies that fit within a constructivist, student-centred framework. The strategies examined are: 1) electronic discussion groups, 2) use of MS –Netmeeting software for constructing models, 3) electronic portfolios, and 4) the critical assessment of resources from the internet that might be integrated into Language Arts curriculum. The study is exploratory in the sense that initial attempts at using the technology are reported, in order that they may be critiqued and refined for future use.

Coding Discussion Groups to Promote Substantive Discussion

Students in education courses often benefit from face to face discussions of pedagogical content. To assist in the implementation of The Acadia Advantage, software (ACME - Acadia Courseware Management Environment) was developed at Acadia which allows for student participation in asynchronous (Kuehn, 1994) electronic discussion groups (E.D.G's). An added feature of this mode of interaction is the availability of the discussion transcript.

The E.D.G. approach was used as an instructional and assessment strategy in the undergraduate Science Education course. A coding strategy was developed in an effort to promote better quality discussion rather than solely to assign a grade for participation. The hardware, software and specifics of the coding system were explained to students using examples and student-led sample coding exercises. The classes were divided into groups of seven students per discussion group. Readings were assigned and a prompt / question(s) was posed to each individual discussion group. Over a period of two weeks students contributed electronic entries to the discussion group in response to the prompt. After the two-week period, each entire discussion was captured and saved as an MS Word 97 document.

Coding systems for use with written work have been developed for a variety of educational settings by (Bales, 1976; Knight, 1990; Butler, 1992; Adrianson and Hjelmquist, 1993; Ruberg & Moore, 1994). In this case, the coding system used was adapted from previous work on coding. Icons for ten categories of discussion contributions were created using macros in MS Word 97. These categories were: acknowledgement of opinions, question, compare, contrast, evaluation, idea to example, example to idea, clarification-elaboration, cause and effect, and off-topic/ faulty reasoning.

The instructor coded the discussion entries of each individual student within their particular group. Using electronic mail attachments, the "captured" discussions bearing only the individual student's coding, was forwarded to the student. In addition, uncoded discussions were forwarded to the entire class. In order to provide a summary, clarification and closure these discussions were examined in an in-class exchange.

The codes developed were an attempt to highlight specific strategies for contributing to substantive electronic

discussion. Within the coding some categories are reflective of higher cognitive processes. To address this issue, an evaluation scheme of one or two points was used. Codes for acknowledgement of opinion, evaluation and question were assigned a single point while the others were assigned two points (with the exception of off-topic/faulty reasoning which drew no score). It was clear from the first session that ambiguity in the scope of the code made it difficult to assign scores in some situations. In other instances it was difficult to categorise a contribution because it reflected more than one code or it was a contribution not accounted for in the coding.

Following each of the discussion sessions, students were encouraged to raise their grades by contributing more high-level response types in subsequent sessions. Students were aware that contributions should be unique, i.e. after an entry idea was posed to the group the identical point being raised later yielded no score. This feature helped to discourage students from simply stating their opinion totally oblivious to other participant's input.

One might predict that students would not be spontaneous in their participation in the electronic discussion group. However, in this case it was found that students' contributions were excessive at times to an extent that future attempts may include a page limit. This situation may have been due in part to the fact that students would be graded to a maximum score of ten. In a few instances it was clear that students accumulated many single point scores to the maximum and did not improve their discussion patterns. This however was not the norm. Many students improved their scores as well as proportion of higher level contributions in subsequent discussions. This finding raises questions related to the teacher's role in facilitating electronic discussion groups. Future directions might include examining the effect Kuehn (1994) refers to as "a conversational style of teacher messaging" whereby the teacher participates actively throughout the discussion.

ICQ and MS-Netmeeting Projects

In addition to establishing computer-based discussion groups in Science Education courses, in Language Arts one of the goals was to have students experience opportunities to collaborate and co-operate in-class using their computers. Johnson (1997) identified that interactive computer technology has tremendous potential for teaching the Language Arts. Prior to Acadia Advantage, students in this course were required to construct models of their learning. These activities were conducted in groups, to give students opportunities to work together and learn from one another.

When Acadia Advantage was implemented an opportunity was created to use software to enhance the co-operative and collaborative process in completing these projects. Two software programs were used. The first was ICQ, which operates like a communications sub-network, and allows students to speed-dial one another. It informs an individual when another person is on-line and allows the use of other software programs to be initiated. To complete the task of constructing models of learning, MS-Netmeeting, which allows for an on-screen meeting was used in conjunction with ICQ. Establishing the project with laptops and appropriate software allowed all students within a group to concurrently work on the models from their own computers. Prior to the use of computers in this course, only one person at a time could physically work on the model.

All groups engaged in oral discussions prior to beginning the work on computers. The context was such that it was more efficient for them to verbally discuss rather than communicate electronically as a means for orienting themselves to the task assigned. When creating models all students participated in the creation of the "models of learning" with their computers. However, the manner in which groups approached the task varied. In approximately half of the groups students chose to assume responsibility for various roles. In a particular example, one person was responsible for the graphics, another for aesthetics, a third for the language, and the fourth for the artistry. In this context students appeared to draw on their personal strengths and participated in unique ways within the group. All students participated, yet the manner in which they involved themselves in the task varied. This observation raises a concern regarding the nature of student participation in MS-Netmeeting projects when the group approaches the task by having roles assumed by individuals. In terms of this particular task of designing a model of learning, some roles, such as the use of language and the creation of graphics in the model, appeared to play a more significant part in the creation of the product, than did the roles related to aesthetics and artistry.

In contrast to the groups in which students assumed particular roles in the creation of the model, students in the other groups worked on the various components of the models at the same time. In terms of completion of the task these groups did not appear to operate as efficiently. There were several cases in which students would accidentally erase other students' work. However, in these groups there was more evidence of a dialogical process on the computer screen in the sense that students worked together to revise their thinking and creation of models. The students appeared to view steps in the model creation as more temporary and open to revision than did the groups with assigned roles.

Observational evidence indicated that in general, the use of computers to conceptualize models of learning created a classroom context in which students had the opportunity to share in the process. However, there was evidence to suggest that the manner in which groups approached the task affected the process in terms of efficiency and dynamics of participation of group members. However, this preliminary assessment raises questions

regarding the impact of the use of software such as ICQ and MS-Netmeeting on the development of a democratic context for learning. For example, what does shared power and responsibility look like in a computer-based activity such as the project outlined above? And, does equal opportunity to participate create an equitable context for learning?

Electronic Portfolios as a Class Work Organiser

Electronic portfolios have been assessed and implemented by educators at all levels of instruction (Moersch & Fisher, 1995; Doty & Hillman, 1997; Jackson, 1997; Murphy, Foote, McFarland & Erwin, 1997; Milligan & Robinson, 1997). The use of electronic portfolio in this Science Education course represents a departure from a more traditional sense of the portfolio definition to use of the electronic portfolio as a class work organiser.

At the School of Education each student in the first year class has a Pentium 133 MHz Thinkpad computer with a 1.3 GB hard drive and 24MB of RAM. With the implementation of Acadia Advantage one of the strategies for submitting assignments has been for students to design homepages. These pages containing personal information as well as assignments are then accessible via the Internet. The initial reaction to this was mixed because students did not always want their work to be net-published in an open forum. In response to these concerns professors endeavoured in some instances to password protect sites for individual classes. (i.e. only students in the course for which the page was design are allowed access).

In the Science Education course electronic portfolios were used as an alternative to the homepage format outlined above. To implement the strategy students were instructed in the use of Netscape Communicator Composer. Sample exercises were undertaken in which students prepared documents with text and graphics in MS Word 97. These documents were then saved with HTML extensions. In Composer, students prepared a homepage in which they generated links to the aforementioned HTML documents. Taking the time to allow students to become familiar with the hardware, software and technology was regarded as crucial to the success of this approach because as noted by Adrianson and Hjelmquist (1993), students need to feel comfortable with the technology in order to be successful in electronic projects.

Approximately 75 Science Education students were provided with course outlines of the assignment work to be completed over the term. After preliminary exercises (outlined above) students were instructed to assemble a homepage in the form of table of contents of their course work. Individual students saved their pages to a 1.44 MB floppy disk. As assignments were completed they were linked to their homepages and submitted on their floppy disks. Classwork was e-mailed via the course distribution list to the entire class.

This framework for presenting assignment work is clearly not a traditional portfolio in that students do not choose the work they wish to submit. This format is intended purely as a course work organiser. The types of assignments submitted for these Science Education courses included an introductory philosophy of science education, scanned articles, article reviews, constructivist plans, concept maps, electronic discussion group captures, STS curriculum diagrams, samples of plans embedded with process skills, demonstration outlines, role play plans, plans for integration of music and literature into science, internet resources and a course impact summary essay. As mentioned above, use of a distribution list allowed students to accumulate samples of assignment products from fellow students that they then added to their individual course homepage directory. In theory this exchange is quite facile, in practise it requires significant organisation on the part of the teacher and the student.

Although students were given an introduction to the homepage assembly, some students have noted that more practice at the beginning of the course is necessary to reduce the intimidation associated with the technology. At the other end of the spectrum students with previous experience designing pages felt quite limited in presenting only a simple linked table of contents. The inability to add sound, extensive graphics etc. due to the size of disks was constraining for these people. In classes of 75 students the lack of available Zip drives was a real limitation to this solution. Students appreciated the fact that they could easily formulate a database of other student's work (in particular their lesson plans). Students in general have indicated that their work is much better organised and easier to submit.

Integration of Resources from WWW

With the widespread use of the Internet and the fact that Acadia University students have easy access to resources on the World Wide Web. One of the assignments for the Language Arts methods course was to locate a resource on the worldwide web that might be used in the teaching of Language Arts. Knop, Gebrin and Tannerhill (1997) examined the use of a World Wide Web exploration for a final research project in a teacher-education course. Their findings suggest that the "World Wide Web was fun, easy to access, and rewarding for students who worked with it... Students were doing more problems solving and searching for content driven by related, but interest specific questions, instead of instructor guided inquiry generated by lecture/ lab (p. 680)."

The aims of the assignment in the Language Arts course were for students to choose a web-site, to critically evaluate the resource in reference to the principles of literacy

learning covered in the course and to design strategies for integrating the web site into an elementary school curriculum. It was stressed that for resources to be effectively integrated there needed to be more than an "add and stir" philosophy at the heart of the process.

To assess whether or not students conceptualized the site as a resource within the scope of a Language Arts curriculum, the question was asked whether the site was viewed as a reference or resource that students could use as they participated in meaningful reading, writing, speaking and listening activities in the classroom. In a sample of twenty-six, only two students made no attempt to link the use of the site to other classroom events involving aspects of Language Arts. For these students, the site use was conceptualised as an entity in itself, to be used in isolation of the Language Arts curriculum. The other twenty-four students viewed the use of the site as a resource to enrich Language Arts activities. Generally the site was regarded as a mechanism for bringing into the classroom information and opportunities which could enhance the already existing curriculum. For example, students made reference to the fact that sites can be used to locate resources for students' interest areas when students engage in inquiry projects. Other assignments focused on web-sites that created an opportunity for students to read stories of children from around the globe and to receive feedback on their own stories. Further, some assignments focussed on sites that created the possibility to compose a piece of writing through the use of the site, which could then be shared and discussed with peers in the classroom.

In addition to examining the site as a resource within the core Language Arts curriculum, the assignments were analyzed to assess whether or not use of the site was conceptualized as a resource to integrate language across the curriculum to areas such as Science and Social Studies. While there was emphasis placed on this quality for designing Language Arts curriculum within the course, fifteen students did not make any attempt to integrate the use of the site across the curriculum. In nine assignments explicit statements were made such as learning about different cultures, learning about scientific content from visuals, video clips, and text.

One of the goals of the assignment was to develop a critical disposition towards the use of resources from the Web. Students were instructed to assess the quality of the site as a resource in reference to the principles of literacy learning examined in the course. Students' efforts to provide a critical assessment were divided into three categories. Assignments in which there was no evidence of a critical assessment, those with some evidence, and those which reflect a careful assessment based on the principles of literacy learning covered in the course. Four assignments showed no evidence of critical assessment of the web-site. Twelve assignments demonstrated some attempt at critical assessment and ten students were both explicit and comprehensive in their assessment.

In assessing the nature of the student's projects in reference to aims of the assignment it was clear that students searched out web-sites based on their own interests and what they believed would be useful for developing a Language Arts curriculum. For the most part, the assignment created a mechanism for students to explore teacher resources with relative ease and wide range of availability. The sites selected were generally conceptualised as an opportunity to bring valuable and useful resources into the classroom that could be integrated into the Language Arts curriculum. For the most part students were not overwhelmed by glitter and glitz of some web-site but rather reflected on its relevance to a Language Arts curriculum. However, in many cases evaluation of the web-sites was not conducted in a manner that reflected an explicit consideration of the principles of literacy learning covered in the course. Given that importance for teachers to evaluate resources and justify their recommendations it would appear that modifications may be necessary. It would appear students in this case require more explicit attention to the process of how to evaluate web-sites as a resource for teaching. In the future, the process of critical assessment will be modelled though a think-aloud strategy. The instructor will use a data-projector to display the web-site to the class and then articulate the process of critical assessment with explicit reference to principles of literacy learning and assessment criteria for examining the site.

Concluding Remarks

Acadia University is an ideal environment to investigate the pedagogically-sound use of computers in teaching and learning. The work discussed here encompasses four strategies used in the teaching the core curriculum areas of Language Arts and Science. The instructors aimed to use teaching and learning strategies that fit within a constructivist, student-centred approach to curriculum.

For the most part the experience of teaching in The Acadia Advantage project was exciting and stimulating for instructors and students. As might be expected the strategies discussed above would be modified in the future. Student feedback and instructor reflection should assist in the process of refinement and modification in the future. It is through the close and critical examination of the strategies that sound-pedagogical practices will emerge from attempts to implement computer-based technology into the classroom environment.

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PROJECT INSITE: INTEGRATING INFORMATION TECHNOLOGIES IN PROJECT-BASED SCIENCE

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Current reform initiatives in science education such as *Project 2061: Science for All Americans* and *Benchmarks for Science Literacy* from the American Association for the Advancement of Science, *Scope, Sequence & Coordination* from the National Science Teachers Association, and *Science Education Standards* from the National Academy of Sciences stress the need for the development of scientific literacy. For the most part, these reform documents also stress the importance of process or inquiry approaches to science, realistic problem-solving for students, and integration rather than segregation of content disciplines (Willis, 1995).

Underlying these calls for reform in science education is the constructivist view of learning. At its core, the constructivist position argues that knowledge is not transmitted directly from one person to another but must be actively built up by learners (Driver, Asoko, Leach, Mortimer, & Scott, 1994). While constructivism is often viewed from either cognitive (within the individual) or socio-cultural (within a community of learners) perspectives (Cobb, 1994), learning science can be seen to entail both personal and social processes (Driver, et al., 1994). As a result, most calls for reform in science teaching emphasize engaging students in inquiry, promoting active development of understanding by individuals, and having students collaborate in small groups, promoting communication and the development of shared meaning.

One way to help students apply what they learn in school to real-world situations is to situate learning in authentic activity (Brown, Collins, & Duguid, 1991). Technology, while perhaps not essential to this view of learning, is seen by many as a unique agent that can anchor students' learning or support/augment construction of meaning (Cognition and Technology Group, 1991; Kozma, 1991). So, technology is often mentioned as an important element of reform efforts (Adams, Krockover, & Lehman, 1996).

A promising approach to school science teaching/learning which incorporates all of these elements of reform is project-based science. While its bases are not new, project-based science in its current form is a relatively recent development (Krajcik, Blumenfeld, Marx, & Soloway, 1994). Project-based science is characterized by: a) a driving question that is meaningful to the learners and that is anchored in a real-world context; b) student-conducted investigations that result in the development of artifacts and products; c) collaboration among students, teachers, and the community; and, d) the use of technology tools to help students represent and share ideas (Krajcik, et al., 1996).

In a "typical" project, a group of middle school science students might tackle a driving question such as, "What is in our water and how did it get there?" The driving question, which is meaningful to the learners because of its direct relevance to their lives, provides a clear but broad framework that affords ample opportunity for student-generated investigations in real-world contexts. Working in teams, students must generate questions, plan investigations, and evaluate their feasibility. Once particular investigations are determined, students do background research as well as collect and analyze data, such as sampling and testing water from a local reservoir or team members' household taps. In this process, students work together, collaborate with their teachers, and often communicate with members of the community who can assist with some aspect of the investigation. Science content is addressed as it arises naturally out of the context of the investigations. The results of the process are artifacts (e.g., water samples, test results, graphs) and products (e.g., reports, multimedia presentations, portfolios) produced by the students. Technology plays an important role throughout the process as a tool for gathering information, analyz-

ing and representing data, and for communicating the results. The project provides a pivot around which science and technology learning, as well as learning in other subjects, can revolve.

Project INSITE: An Indiana Project-Based Science Initiative

Project INSITE, Institute for Science and Technology, is a school-based project that embraces science education reform and the approach of project-based science. The goals of the project, which is targeted primarily at grades 5-9, are to: a) provide the pedagogical and philosophical foundations for improving science education; b) develop strategies to increase students' active learning of science; and c) develop a delivery system that enhances the roles of both students and teachers in order to create an environment that encourages creativity, critical thinking, and communication through the use of information technologies. The project is directed by staff members of the Eagle-Union Schools in Zionsville, Indiana, and it includes a partnership of Indiana school districts, Purdue University, the Indianapolis Children's Museum, Indianapolis Zoo, Indiana Cooperative Library Services Authority, Eli Lilly Research Laboratories, Dow Elanco, and others (Krockover, Lehman, Buchanan, Rush, & Bloede, 1997).

The project is in the third year of a four year effort to help teachers learn to implement project-based science activities in their classes. Following an orientation session in May, participants attended the 1997 summer institute, which took place in Zionsville, Indiana (an Indianapolis suburb) and surrounding sites during a three week period between June 23 and July 11, 1997. The institute was divided into three phases. Phase 1 involved a project-based science modeling activity, phase 2 provided participants with the opportunity to observe science and technology in action, and phase 3 was devoted to curriculum development and to the development of participants' technology skills. The summer institute focused on helping in-service and pre-service teachers understand how to develop learner-centered, project-based approaches to science teaching/learning involving appropriate uses of information technologies.

Summer Institute Approaches

There were fifty-seven participants including six pre-service teacher from Purdue University and fifty-one in-service teacher from fifteen Indiana school districts involved in the 1997 institute. As noted above, it was divided into three phases. Each of these is described in more detail below.

During the first four days of the first week of the institute, participants were introduced to the institute in the form of a modeling activity. The purpose of this modeling activity was to have participants: a) engage in project-based science activities as learners; b) analyze the components of a project-based science activity in terms of the roles of the teacher, students, and technology; and c) develop a driving question to guide their own project. On the first day, participants were introduced to the institute and the modeling activity; teams of participants were formed, brainstormed investigations related to the driving question "What is in our water, and how did it get there?", and planned an investigation. On day 2, teams of participants conducted an investigation related to the driving question. Teams went into the field and collected data with respect to their investigation. One team tested tap water samples. Another team tested freshwater samples from area streams and reservoirs. Still another team tested water upstream and downstream of an area landfill. On day 3, the teams analyzed the results of their investigations and prepared presentations about their investigations. Teams used technology to find relevant information (e.g., Internet research), to analyze data (e.g., spreadsheet software), and to prepare the presentations of the investigations (e.g., Powerpoint). On day 4, teams shared their presentations and reflected on the process that had taken place. The modeling activity set the tone for the entire institute by showing the participating teachers what project-based science looks like and how it can occur.

At the end of week one, participants developed their own driving questions related to the theme "models" taken the AAAS Science Benchmarks. The 1997 driving questions were:

- What's in an ecosystem and how does it change?
- What makes things stop and go?
- What pollutes our environment and how does pollution affect us?
- How does weather affect our environment?
- How do we affect the life cycles of plants or animals in our environment?
- How does genetics affect my everyday world?
- What is in our soil and how does it affect us?
- How do Indiana aquatic ecosystems work?
- How and why do things fly?

Phase 2 of the institute was devoted to establishing links with the scientific community. A series of site visits was arranged to give participants the opportunity to observe and interact with practicing scientists. All of the participants visited Dow Elanco, an agricultural research center in Indianapolis. During this visit, participants were able to tour working research laboratories and hear a panel discussion by staff scientists who stressed the collaborative, problem-solving nature of "real-world" science and the integral part that technology plays in their everyday work. Participants could elect visits to other area sites such as: Eli Lilly Research Laboratories, Indianapolis Children's Museum, Indianapolis Zoo, National Weather Service, U.S. Geological Survey, and others. At the end of week 2, the

1997 participants also had the opportunity to interact with and see project summaries by the participants from the previous project year. This provided a bridge from one project year to the next and gave the new participants the opportunity to learn what sorts of activities do and do not work well in the classroom.

Phase 3 of the institute was devoted to curriculum development and to the development of participants' own technology skills. In groups related to their chosen driving question, teams of participants worked together to outline planned activities and develop curriculum materials for implementation during the 1997-98 academic year. Technology training was also provided during week 3 in the form of a series of short workshops on topics of interest to the participants (e.g., Internet searching, Web page development, multimedia, etc.). The culmination of the institute was the production by each group of a set of curriculum materials designed to include: a) learner-centered and project-based science, b) appropriate integration of technology, cross-disciplinary and cross-grade elements, and c) a timeline spanning several weeks. Preliminary lesson plans for these projects were posted to the project Web site at: http://www.projectinsite.org.

Methods and Data Sources

The evaluation of the Project INSITE summer institute was designed to address the process and product categories of Stufflebeam's (1983) CIPP evaluation model with special focus on Kirkpatrick's (1979) scheme for training evaluation. Guiding questions were developed within this framework. These included: What was the nature of the training participants received?, What were participants' perceptions of the institute?, and Did participants attitudes toward science teaching and/or technology usage change as a result of the experience? During implementation of the teacher-developed project-based activities during the 1997-98 academic year, the evaluation will also examine implementation questions.

To evaluate the summer institute, data were collected from a variety of relevant sources. These included: a) pre- and post-institute administrations of questionnaires assessing participants' attitudes towards science teaching and attitudes towards computers; b) pre- and post-administration of technology usage checklists; c) a Likert-type survey of participants' attitudes toward the institute; d)an open-ended survey of participants and their perceptions of the project; e) on-site observations of the institute; and f) interviews with participants and staff facilitators. Pre-institute questionnaires were administered to participants during the initial project orientation session prior to the institute in May. Post-institute questionnaires were administered during the last two days of the summer institute in July. Quantitative data were compiled, and descriptive statistics were calculated. Means of pre- and post-institute attitudinal data were subjected to paired samples t-tests to determine if, on average, participants attitudes changed over the course of the institute.

Outcomes of the Summer Institute

Participants showed improvement in technical knowledge as a result of the institute. Based on pre-institute and post-institute administration of a technology checklist, overall knowledge gains were noted in several categories related to what was offered or used during the institute, including: integrated software packages (ClarisWorks, Microsoft Works), multimedia (HyperStudio), presentation software (Powerpoint), Web browsing (Netscape), and the development of Web pages (Claris HomePage). Participants' computer attitudes did not show any real change as a result of the institute. However, their computer attitudes were already quite positive and a ceiling effect likely resulted.

Participants' attitudes about science teaching were assessed using pre-institute and post-institute instruments adapted from the work of Bratt (1973). This measure assessed participants' attitudes toward science teaching in twelve categories, half positively and half negatively worded. For each category, represented by a statement, participants could receive a score of up to 6, indicating the most positive attitudes. Positive shifts were observed in 11 of 12 categories; in five categories, this positive shift was statistically significant. See Table 1. These shifts corresponded to a lessening of a teacher-centered view of science teaching and a movement toward a student-centered view. These outcomes were consistent with the aims of the institute and suggest that the institute was successful in helping to change teachers' attitudes.

Participants' reactions toward the summer institute were generally quite positive. Over 90% of the participants rated themselves somewhat to very satisfied with the summer institute and somewhat to very enthusiastic about the project. The technology training and the week 1 modeling activity were the most positively viewed aspects of the institute. Participants also enjoyed collaborating with other teachers and learning to develop project-based science activities.

Conclusions

Overall, the 1997 Project INSITE summer institute was the most successful to date. All of the major reform efforts in science education today make similar suggestions. A scientifically and technically literate populous is essential to our future, and, to achieve that goal, science education must take new approaches. These include approaching science from a hands-on and inquiry-oriented perspective, making science more relevant to the real world of the students, and using technology appropriately. In order for these changes to be effected in the classroom, teachers must receive training that will help them move from the teacher-

centered practices of the past to the student-centered approaches that are advocated. Effective models of teacher training are needed. Project INSITE represents one approach to teacher training for project-based science and technology. Others may wish to replicate this approach to bring about the needed changes in science education.

Table 1.
Participants' Science Teaching Attitudes, Pre-Institute and Post-Institute

Statement Describing	Pre-Institute	t-value	Mean (SD)	Mean (SD)
	Post-Institute	Prob(t)	Science	
			Teaching Category	
1. The idea of teaching science is attractive to me; I understand science and I can teach it.	3.85 (1.50)	4.09 (1.35)	1.91	0.0622
2. I do not like the thought of teaching science.	4.84 (1.46)	5.05 (1.64)	1.48	0.1448
3. There are certain processes in science which children should know, i.e. children should learn how to do certain things.	4.53 (0.90)	4.67 (1.15)	0.82	0.4177
4. There are certain facts in science that children should know.	3.21 (1.26)	3.63 (1.15)	2.16	0.0352
5. Science teaching should be guiding or facilitating learning; the teacher becomes a resource person.	4.61 (0.91)	4.89 (0.98)	1.65	0.1042
6. Science teaching should be a matter of telling children what they are to learn.	4.38 (1.05)	4.87 (1.12)	2.79	0.0072
7. In education and teaching, the needs of students and teachers should be more important than the subject matter.	4.39 (1.09)	4.20 (1.29)	-1.30	0.1987
8. In education and teaching, covering subject matter, i.e. science, should be more important than the needs of the students.	4.11 (1.13)	4.42 (1.15)	1.76	0.0843
9. Educational programs should find teachers and students working together for mutual benefit so that both learn something.	4.56 (0.94)	4.84 (1.10)	2.17	0.0343
10. Teachers should be the authority in the teachers and students working together for mutual benefit so that both learn something.	2.84 (1.26)	3.49 (1.50)	3.24	0.0021
11. Students and teachers alike are responsible for the learning that takes place in a classroom; students should have as much say about the learning activities and their evaluation as the teacher.	4.88 (1.08)	4.98 (0.93)	0.54	0.5905
12. The teachers should be the sole determiners of activities; they should plan and evaluate each day's work.	4.00 (1.33)	4.82 (1.11)	4.72	0.0001

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Integrating Technology and Science, A Model at Nebraska Wesleyan University

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The purpose of this project is to demonstrate an effective way to integrate technology instruction into the science methods course of pre-service elementary and middle school teachers at a liberal arts university. Science and technology instruction are seen as being extremely important in preparing today's students for the future (Bybee, Buchwald, Heil, Kuerbis, Matsumoto, and McInerney, 1989). Lack of application is often a problem with science instruction and use of technology is frequently taught in isolation from methods classes. Too many times pre-service teachers do not learn to actually use technology in practica and student teaching but only design technology projects for pre-service requirements and infrequently utilize what they have learned. At Nebraska Wesleyan University the technology skills learned in Education 187, Instructional Technology, are integrated with expectations and assignments in Education 244, Teaching Science in Elementary and Middle School.

Avoidance of science teaching by elementary teachers is a concern in many schools (NSTA, 1997). As teacher educators who supervise pre-service teachers in the field we have observed avoidance of teaching of both science and technology by pre-service teachers. Lack of confidence and training, time constrictions, pressure to focus on the three R's, and management concerns are cited as reasons for the avoidance of teaching science (Victor and Kellugh, 1997). One of the goals of our model for integrating technology and science is to increase the probability that Wesleyan pre-service teachers will more effectively teach science while also integrating technology in their pedagogy.

Background

Nebraska Wesleyan University is a liberal arts institution in Lincoln, Nebraska with approximately 1,700 students. The Education Department has approximately 230 students, all required to take Education 187, Instructional Technology, a 3 credit hour course. All students who are majoring in elementary education complete Education 244, Teaching Science in Elementary and Middle School, a 3 credit hour course in addition to other necessary method classes (Math, English, Social Studies, Music, PE, Art, and Reading). We will concentrate upon Science because this is the first time we have utilized our model and because of practicum logistics at Huntington Elementary School at Lincoln, Nebraska. It should also be noted that one of the main goals of Nebraska Wesleyan and the Education Department is to foster collaboration with surrounding school districts while modeling the effective integration of technology. Consequently, collaboration with Huntington Elementary, a school within the Lincoln Public School District will also assist all involved parties.

Procedure

Education 244 included a two hour per day, two week practicum experience at a local elementary school. The practicum took place late in the term after the pre-service teachers have received instruction in "doing science", the scientific method, science topics, pedagogy of science teaching, inquiry, planning science lessons and units, and assessment techniques. Instruction was given in integrating science with the curriculum and meeting the needs of individual and special needs children. National Science Education Standards were used to guide instructional decisions of the course instructor and the pre-service teachers (National Research Council, 1996).

Education 244 was taught as an active, hands-on course, thereby modeling good science teaching for the involved pre-service teachers. When it is taught as an active, hands-on experience, science is often the most interesting subject taught in elementary school (Howe & Jones, 1998).

Early in the term students in ED 244 were grouped into pairs. Partnerships were determined by grade level for which students are preparing to teach. Each set of partners were required to create a thematic interdisciplinary unit for use in their practicum. Copies of all unit/s and activities were made for all class members to include in their personal teaching files. By the end of the semester, pre-service teachers compiled files of science units and lesson plans

including numerous hands-on exploratory activities which they were able to access from the website as well as from their personal files.

Each student taught one lesson from the unit in a simulated peer teaching situation where students first microteach at Wesleyan. After receiving feedback from peers and instructors, students then refined lessons prior to presenting at practicum. Instructors found that peer teaching prior to delivering lessons was effective in preparing practicum students to teach more confidently during their field experiences. Peers reflected on these experiences and made suggestions for improvement.

Themes of the units came from any topic within the areas of technology, physical science, life science, or earth and space science. No two units may use the same topic. In this way the students gained exposure and materials for teaching as many topics as possible.

Following introductory sessions in which students experienced hands-on science lessons and review basic science concepts such as the metric system, measuring, observing, and data gathering and reporting, partners chose their unit's topic. Students were expected to increase their knowledge base on the topic, to explore existing lesson plans for teaching the topic, and to create original lessons and activities to use in teaching the topic. Information that is gathered was included in the web page that each pair began creating the second week of the term.

During the last month of the semester, pre-service teachers were on-site at a culturally and socioeconomically diverse, K - 6 school for two hours everyday for two weeks. Students visited the classrooms on three earlier occasions to build rapport with the students and the teacher, and to learn the classroom routines. Classroom computers, the school computer lab, and Nebraska Wesleyan equipment were used as the partners teach their science units and facilitate the children in creating web pages. The complexity of the children's web pages was determined by grade and age level, the nature of the unit topic, and the computer skills of the children. These web pages were placed on previously created partners' web pages. Practicum journals were kept by each pre-service teacher in which he/she was asked to relate events and episodes that occured during teaching and to reflect on those experiences.

During the last week of the term, students ED 244 returned to campus. Partners shared their web pages in a "Celebration of Learning" with fellow students, parents, cooperating teachers and Wesleyan Education Department members as well as any other people whom students might want to invite. The main intention of the "Celebration of Learning" was to have students present and critique their units and websites while professionally discussing the strengths and weaknesses of their work. A rubric (developed in class) and based upon the Web Page Project Information. will be utilized to evaluate presentations and the website (http://206.252.190.23/tips/webpagerubric.html, 1997).

Technology Instruction. During the second-third weeks of the semester, students met in the Wesleyan Computer lab and learned how to utilize Adobe PageMill, a webpage editor. Students learned the basics of HTML while initially designing a science-related website. At this point, students simply began designing their site—website scaffolding— and in the course of ED 244 conceptualized their unit topic while also collecting URLs for placing on the website. Students also viewed websites created by previous ED 187 students. The main intent was to teach how to effectively search the Internet for lesson plans while also acquiring skills to effectively utilize technology. Emphasis was on developing and utilizing hands-on science lessons through the use of students' websites.

Students had the option to seek assistance through Sunday night labs and also sit in on ED 187 if they had not taken 187 and wanted added assistance. Periodic classes (2-3 throughout the semester) were established to provide continued assistance in developing the website/s.

Students also learned how to use a digital camera and scanner. Both multimedia tools were utilized in two main manners: adding personal and science related images to the website; and in involving practicum students at Huntington Elementary School through taking pictures and scanning artifacts of preservice students' work. Each of these aspects modelled hands-on learning while also continually developing the initial website.

The websites were utilized in on-campus microteaching to provide opportunity to refine prior to utilizing at practicum. Refinements were made and students were shown how to save their projects to a Zip disc (allows storage of 92 MB) so that students could simulate a live connection while also establishing which URLS Huntington students could actually access. This consideration allowed students to individualize learning yet ensure that Huntington students fully learn the science-related information which was required by lessons.

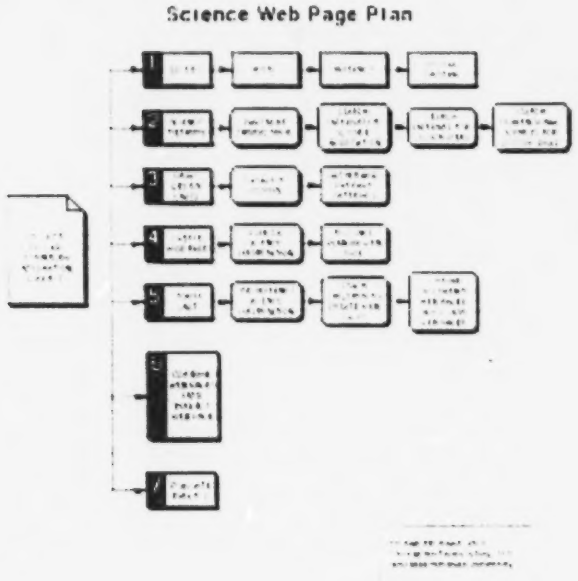
All students websites were linked to one another so that students could learn from each other while also allowing Huntington students to link to more resources. Again, the concept of website scaffolding was modeled as students designed their own website while learning basic HTML elements. Ongoing development allows students to increase the complexity and capabilities of individual websites while also linking to website of fellow students. In turn, the maintaining of sites on the Wesleyan server (at least one year beyond graduation) allows students to access the websites beyond the formal practicum while extending into other practica and student teaching.

Students were required to utilize their website at their practicum while journaling about the experience and sharing with classmates about general effectiveness.

Students discussed the effectiveness of using their site by presenting at the "Celebration of Learning" that was held during Finals Week. Involved participants provided a 15 minute presentation which was evaluated by fellow ED 244 students and faculty. Each opportunity to present allowed students to develop enhanced professionalism and ability to reflect on pedagogy.

The flow chart in Table 1 illustrates the elements of the model and our plan for implementation. The model is being used for one 18 week semester.

Table 1.
Model elements and plan implementation



Objectives of Model for Integration:

1) Students explore the Internet for science information and for lesson plans that can be used in teaching science to elementary students.
2) Students learn HTML and how to use a web editor, Adobe PageMill, to create web pages.
3) Students learn to use a digital camera and to incorporate pictures into web pages.
4) Students create science teaching units on various topics within the science curriculum.
5) Students create web pages which will be integrated in teaching science units and links to scientific information.
6) Students teach the science units to elementary or middle school students in a practicum experience.
7) Students teach elementary and middle school students to create themed web pages as part of their science units.
8) An overall web page links all web pages of pre-service students so that students can access fellow classmates' website information..
9) Web pages created by the pre-service teachers connected with an overall web page on the Nebraska Wesleyan Education Department server accessible to future practicum students and for use in student teaching.
10) Enhance collaboration between K-12 and higher education.
11) A repository of website-based activities for use in math and science classrooms established and maintained on the Nebraska Wesleyan University server. These activities continually developed and refined for use in preservice and inservice classrooms.

Evidence to Evaluate Project Success

The project utilized formative and summative evaluation to assess success. Evidence to judge success included:

1) Preservice students maintain journals during the course of the project. The journals provide general attitudinal feedback on the use of science lessons and effectiveness of integrating technology
2) The websites utilized in science classrooms. These websites maintained on a Nebraska Wesleyan University server will be accessible beyond the funding of the project thus sustaining the impact of the project. The websites were evaluated with a class designed rubric which will be based upon the rubric of "The Web Page Project Information" (http://206.252.190.23/tips/webpagerubric.html, 1997).
3) A mid-term examination administered over introductory science concepts and teaching pedagogy (information presented weeks one through eight).
4) The number of preservice teachers attending the Nebraska State Technology Convention provide informal assessment of teachers' attitude toward use of technology while also allowing students to gain ideas and network with inservice teachers.
5) Enhanced collaboration between Nebraska Wesleyan University and Huntington Elementary School and providing "in kind" support for the support of preservice students. Evidence determined from informal interviews by instructors.
6) A "Celebration of Learning" held during Finals Week. Involved participants provide a 15 minute presentation evaluated by fellow ED 244 students and faculty.

Dissemination of Plans and Findings

Instructors will disseminate plans and findings by submitting a proposal for presenting at Nebraska State Educational Technology Convention and encourage involved parties to attend. All websites and information is

maintained on the Nebraska Wesleyan University server so that preservice students and inservice teachers may access beyond the actual project. Project results shared with Nebraska Wesleyan University Education Department members. Preservice students encouraged to utilize websites and science-related materials in other practica, student teaching, and later in assisting overall school improvement in becoming inservice teachers.

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TEACHER EDUCATION ONLINE: TRIALS, TRIBULATIONS, AND SUCCESSES OF COURSE DEVELOPMENT

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In 1998, the University of Texas (UT) at Austin, the University of Texas at Brownsville, and the University of Texas at San Antonio received a grant to collaborate and develop an online master's degree in educational technology. The grant allowed the universities, all in the UT system, to pilot four courses. The courses are delivered through electronic means and without regular, face-to-face meetings. Students enroll for a course through their own institution, although the course may be delivered from another, partner institution.*Computers in the Classroom*is one of these pilot courses offered through the University of Texas at San Antonio (UTSA). At this writing, the course is still under construction. Rather than describe the logistical and administrative aspects of the project, this paper focuses on the actual course development. It describes the process of course development and the course design, including considerations of the learner, content, activities, delivery and assessment.

Bigelow (1997) has identified six premises of learning which underlie a course of study and which can provide a basis for World Wide Web (WWW) course development:

1. "Learning as goal-based". The more clearly goals are stated the more likely a student will understand them and be able to engage in active knowledge construction. In a web-based course, goals must be stated in several ways and in several places to ensure that students read and understand them.
2. "Learning as resource-supported activities"Traditional activities, such as reading, discussion, or observations, often rely on materials that support learning. Web-based courses typically rely on web-based materials that may not be easily or consistently accessible. Instructors must be prepared for the unavailability of Internet resources. They must also provide ways to insure that all students have accessed materials and are accountable for using them.
3. "Conceptual thinking". Learning concepts requires study, practice, and application. Without face-to-face interaction, the instructor must find ways to observe and evaluate student's conceptual understanding on an ongoing and documented manner.
4. "Use of feedback". Regular and timely feedback is critical to student learning. The method of feedback may be a consideration of the individual student's preference or style and the instructor's skills (Thatch & Murphy, 1995). Students expect feedback to be immediate when using e-mail. This may not always be possible for the course instructor in asynchronous communication. It is important to explain feedback and response processes to students and to model them.
5. "Active learning". Students can develop learning skills and strategies by participating in selecting learning activities and sharing information with their peers. This requires some flexibility in the course design for the students to make decisions about what and how they will learn. Students are afforded a greater opportunity to participate in ways they might not in a face-to-face situation (Harasim, 1996). E-mail, web-based discussions, and discussion lists are asynchronous and provide more opportunities for active participation than a traditional course meeting.
6. "Learning motivation". An intrinsically motivated student will be more likely to be actively engaged in the learning process. To increase motivation, the instructor can help students make connections between the course content and the student's practical world. For web-based courses this may mean requiring students to write, observe, survey, or discuss local environments, situations, or policies.

These premises provide the framework for the course, one that would be taught differently, with identical content, in a traditional learning environment. Before determining goals, content, and learning activities, the learner must be carefully considered.

Starting with the Student

The student must be the focus of an online course. What the students already know and what they need to

know are primary concerns, just as they are in traditional course development. The critical difference is that for an online course the instructor must consider the technical skills of the students and the unique nature of computer-mediated communication (Mason & Kaye, 1990).

The students enrolling in this course come from three very diverse demographic areas with a wide range of social, academic, and work backgrounds. Some are K-12 teachers, some are full time graduate students who are not working or have never taught, some are librarians, and others are technology coordinators. One issue that concerned the UT partners about the differences among populations was the question of acceptable performance standards. These were not the same for the three participating universities. What might the standard at one institution was not at another. For example, not all partners felt that it was reasonable to expect sophisticated writing skills because writing expectations were lower at one of the institutions. Eventually, the partners agreed upon basic guidelines for performance, although assessment standards reflect the individual institutions.

During the advising period before registration, it became obvious that entry-level knowledge of the content varied enormously among students. One illustration of this disparity is student understanding of the Internet. Some students were well versed in Internet resources and functions, while a few had never used e-mail or a web browser.

In order to design a course that would match the learner's needs, a discussion list was created to keep in contact with potential students. As the course evolved, students were asked for feedback. The students had similar questions about the use of computers. These questions and student feedback about course design were used in revising the structure and organization of the course.

The diverse nature of the student population means that there must be flexibility in the course, both in how the students work online and in the focus of their learning. To help less knowledgeable students, the course web site includes links to sites that might help students review and practice online skills before beginning the class. Students also have options in how they turn in assignments and how they interact with classmates. Printed assignments, telephone calls, and face-to-face meetings are encouraged if students are not comfortable in relying on the use of web-based resources and e-mail. The intent for these modifications is not to diminish the advantages of distance learning but rather to start the course where the learner is. After carefully considering the learner's requirements and suggestions, course content can be designed and organized.

Organizing Content

The nature of the UT collaborative effort in of itself shapes part of the course content. UTSA does not offer this graduate course, although the other partner institutions do. UTSA does have an undergraduate course in which students learn the technical skills for using hardware and basic software, so the graduate level course more appropriately focuses on the application of and guidelines for computer use. The most important considerations for developing content were threefold: the learner, existing guidelines, and resources available.

With the support of a graduate assistant, Sarah Vinch, the author wrote goals, identified entry- level behaviors, analyzed content, and wrote performance objectives. Sarah also kept an ongoing list of terms and definitions that will serve as a student glossary in the web site. The author and Sarah also visited many other web-based course sites and read much of the literature about web-based courses. At first a textbook seemed unnecessary since there was so much information available on the Internet. After talking with students, however, the author decided that the students needed something concrete to which they could refer. After the basic objectives had been determined and correlated to the text, and web-based resources, the course content was organized

A concept map helped to illustrate the relationship of identified course concepts. Major concepts for the course include: instructional purposes for computer use; technical skills and knowledge of software and hardware; curricular applications for computer use; cognitive theory as it relates to computer use; and guidelines for computer use. The questions generated by the students matched well with these broad topics.

Once the focus of the course was determined, related questions were clustered into learning modules. Objectives and questions were correlated and activities were developed. This question-based approach allows for flexibility in content. For example, one module focuses on the following questions: What computer skills are appropriate for certain ages? How can level of computer skills be determined? What existing guidelines support or limit or clarify the use of computers in the classroom? The district technology coordinators are interested in both teacher and learner skills so they look at these questions with the idea that they will be responsible for informally or formally evaluating teacher competencies and supporting teachers to integrate computers at a given grade level. The elementary school teacher sees these questions as relating directly to students and focus more on classroom applications. All course participants will answer the same questions from their own practical perspectives. Determining how students would answer these questions requires a careful analysis of the nature of the medium and the role of the course instructor.

Developing Learning Experiences

Harasim (1996) notes that computers can increase the participation of all learners through "expanded educational access", "collaborative learning and teamwork", "active participation", and "fluid roles". The role of the instructor

must be that of a guide or facilitator rather than that of a director of activities. These qualities are incorporated into the course in several ways.

The purpose of the distance learning course is to provide expanded access of credit hours to a geographically remote population. Harasim (1996) believes that "networks are social places with the potential to be more egalitarian than other media for social interaction". There was, however, some concern among the UT partners that students would not have access to the technology required of a web-based course. As a means of addressing this possible limitation, students are informed of the minimal level of technical expertise and access they need to take the course. They are asked to take a web-based survey, which analyzes their skill ability and probability of successfully completing an online course.

Most students express an interest to work from home, even though most have high speed access to the Internet either at work or at their local university. The course 'place' is a web site with minimal graphics and no frames to allow students with slower connections to open the site without a time consuming wait. Collaborative activities are mostly e-mail-based, the lowest common computer-mediated denominator among students. A toll-free telephone number allows students easy and free access to the instructor. These technical factors can determine the degree of participation for students with disparate skills, computer hardware and software.

The course supports collaboration in several ways. Students have both independent and collaborative tasks to perform. Independent tasks involve readings, observations, and interviews, both on- and offline. Collaborative tasks involve discussions, mentoring, and group projects. An e-mail discussion group is facilitated by a different student each week. This helps the students get to know each other, ask questions, and get feedback or confirmation for their ideas. Each student also mentors a preservice education student with developing lesson plans that incorporate technology. Finally, students work together on both short and long term assignments and projects. The course instructor facilitates the groups, making sure everyone participates and gives individual feedback when necessary. The use of e-mail not only makes sure that students can communicate readily and in a technically simple manner, it may also assist students in being more forthcoming with problems or concerns (Montgomerie & Harapnuik, 1997; Bird, Lee, & Baumbach, 1996).

The collaborative projects, mentoring, and discussions also encourage the active participation and fluid roles mentioned by Harasim (1996). Roles are determined by the nature of the task, student expertise, and access to resources. Students collaborate with each other on different tasks requiring them to listen and act responsively since they are communicating in a text-based environment.

Options in learning activities allow students to make decisions about how and what they are learning. Each learner comes to the class with prior knowledge — curricular, instructional, or technical — that can be readily shared with less knowledgeable peers. The instructional options also allow for individualization. For example, the librarians look at the use of software very differently than a middle school science teacher. After learning the basic applications of software, a librarian may choose to investigate the most pertinent software for the computers in the library while a science teacher may choose to analyze software programs to determine which best fits her instructional needs. The instructor encourages students to look at computers through individual interests in order to relate it to the world in which they practice. They are entering a new learning environment, which requires new ways of interacting and communicating, when they take a web-based course.

Delivering the Course

The course medium requires that students and instructor reconceptualize attendance, collaboration, and participation. In a traditional class a student may raise their hand, stop by the instructor's office, or visit with peers after class, new techniques for the same activities must be provided.

The main 'place' of *Computers in the Classroom* is a web site with links to non-course sites, interactive areas, and information areas. The course also includes three, two-way audio and video sessions at the beginning, middle, and end of the course. Local students are encouraged to visit each other and the instructor for face-to-face meetings. In order to develop a sense of place for the course, the electronic tools must support interaction, locating information, and communication of information.

Students may not perceive the personality of the instructor or other students in computer-mediated situations. Students may not feel that the instructor is doing their job due to the lack of visual information and feedback (Gunn & Tucker, 1997). To help eliminate this potential barrier the author created one web page devoted to sharing personal and professional information, through text and pictures. This information can help the students see each other and make connection with their classmates.

Communication between students and the instructor is critical to the success of an online course. Students sometimes interpret instructional terms and tasks differently online than they do in face-to-face situations. They will sometimes respond in phrases or lists rather than with complete sentences or fully developed papers (Campbell, 1996). For this course, standards of writing and responding to e-mail is a topic for open discussion and appropriate use is modeled by the instructor and more knowledgeable peers. Private feedback to students is ongoing and consistent.

In online courses that require both e-mail and web-based materials, students often ask questions or request information that can be located in another electronic place (Campbell, 1996). An open forum area, discussion group, or an area of announcements and updates can help prevent replication. The web site used in this course includes a main calendar, which lists each module's objectives, readings, tasks, and assignments. If a change is necessary, students are informed, via e-mail, to check the web-site.

Time management is another aspect of communication for both students and instructor. Students may be eager to know how much time they should spend on a task or how long a document should be (Campbell, 1996). Deadlines and number of words or text lines for documents may be one solution. Since this course is not organized on a weekly calendar, students must e-mail the instructor each week to explain what they have done and what they are planning to do in the next week. Each assignment includes required length and/or criteria of completion.

Time is also a consideration for the instructor. Most students find e-mail a non-intrusive medium and interact more frequently and more intimately with a course instructor (Campbell, 1996; Harasim, 1996). A computer-mediated course means that an instructor is on call 24 hours a day, seven days a week. In this UT collaboration the number of students enrolled must also be considered. Although this is a graduate course, each institution has a cap of 30 students for a course. This creates a potential enrollment of 90 students the course, since students enroll through their own university. A course with 90 students must be taught differently.

Monitoring student work and progress is a critical aspect of communication and interaction. Since the instructor never sees the student, online evaluation must be regular and consistent. Student openness may differ in electronic environments. If work or messages are shared with all group members, students may be reluctant to have their ideas exposed to their peers (Harasim, 1996). In this course, students interact with the instructor one-on-one via e-mail and telephone to help build trust and openness so problems or insecurities can be overcome. If work is not completed satisfactorily, students are given the opportunity to re-submit within a given time frame.

In collaborative efforts there may be a student who will not participate, similar to what often occurs in face-to-face situations (Gunn & Tucker, 1997). In a Northern Arizona University graduate web-based course, the instructors provided frameworks for assignments in order to reduce learner and teacher load (Gunn & Tucker, 1997). This helps define expectations, reduces question-asking, and lowers student errors in completing tasks, all of which facilitate performance.

Assessment

Learner assessment follows traditional lines and is viewed as a means of motivation and feedback. Assessment is based on student participation in online activities, completion of activities and assignments, and a final product that is negotiated between instructor and students. The final product reflects the student's personal work practices or future goals. Objectives are clearly stated for each module and assignments are given for each objective. If a student feels they have already mastered an objective they may choose to determine a substitution task at a more sophisticated level. Students may submit work as many times as necessary. If the learning activities connect with the student's real world environment, they will be more motivated to revise and resubmit work.

Conclusion

In a study of students who had completed online courses, Campbell (1996) found students perceived many advantages to learning online:

- control over own learning
- independence
- sense of responsibility
- self motivation
- working at own pace
- ability to work at home

The proof of success for *Computers in the Classroom* will be measured by student learning.

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Problem of Developing of Mixed Computer and Non-Computer Methods for Science Teacher Education

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Educational technology can provide teachers of science subjects with access to some different resources for use in the classroom. However, for traditional and modern science education, the computer is only one means of enabling teachers to improve students' knowledge. Thus it is very important to investigate the question of the place of computer- and non-computer methods in science education, because, as usual, the greatest benefit for better teaching and learning is in using the mixed methodology.

The first problem is to find a valid relationship between non-computer and computer methods in teaching, and an appropriate role for them during lectures, seminars and other academic activities. Traditional teaching methods in science are often: explanation with illustration, instruction with reproduction, heuristics and investigation methods, method of resolution of teaching problem etc. Each of these methods has two aspects: external and internal. The external aspect is easily seen in the class as the instructor displays it in his method of teaching and in the organization of academic activities. The internal aspects of the teaching method can be found if one observes in detail the teaching practice with respect to the organization of the cognitive process, methods for developing students' thinking, logical operations and other didactic functions of class activities. (Science Teaching Reconsidered, 1997). Computers are used in science teaching in several aspects of this traditional teaching methodology. The first of these aspects is the facilitation of the illustration of didactic material; for example, in the form of the electronic blackboard. This is one good example of how computers improve the quality of the visual representation during the lecture. Modern graphic packets (Corel, Power Point etc.) allow designing teacher information and produce a corresponding increase in the understanding and perception of the information during the lecture.

Another method of using information technology is the application of simulation software. Teaching demonstrations are very important during lecture in the natural sciences. Modern hypermedia and multimedia software allows the direct demonstration of experimental phenomenon as a part of teaching material. For example, the software in CD- ROMs allows the teacher to show important chemical experiments during lectures on different themes of a chemistry course (ChemDemos Videodisc, 1995). In this case, the computer improves some drawbacks and difficulties of the actual chemical experiment and provides another method (such as a video demonstration) of instruction. Multimedia experiments can be cheaper and safer than the real ones. However, we can not be sure that students will know the material better in the multimedia case, as compared with the traditional live experiment. On the other hand, live demonstration of the experimental phenomenon can be better for developing knowledge and skills.

The next important problem is to find the same correlation of traditional and computer methods during science laboratory activities in physics, chemistry and biology. The first case of this computer application may be the simulation of some laboratory activities. For example, there are different examples of traditional software for analytical chemistry, which allow students to master titrations of different solutions before an actual titration. This independent student work allows them to prepare better for the respective themes of the course. Another common computer application is the processing of numerical data, using spreadsheets and other software, which allows one to calculate and do graphics easily. Both of these methods are very useful and give positive results in students' knowledge, as compared with traditional non-computer variants.

A third important problem is the evaluation of students in science subjects. Written exams involving traditional tasks or multiple choice tests are currently the main type used in classes at the moment. Modern software that evaluates students may eases the evaluation process for the teacher. For example, the program VizQuis contains different kinds of questions for the course of general chemistry and provides the opportunity to design new variants of control tasks for exams (VizQuiz, 1995). Software for knowledge and skills evaluation may have some of the same problems as traditional methods, such as

the lack of variants which evaluate not only lower-order but higher-order cognitive skills (HOCS) (Zoller, 1993). Improving instruction and assessment of HOCS is a very important problem in science education. Thus it is often easier for teachers to utilize traditional evaluation methods of these skills rather than use computer methods.

A similar problem exists with modern Internet tools for learning and teaching science subjects. For example, virtual classes and schools have now become innovative methods of instruction. One of the main characteristics of this method is that students use intelligent software which can play the roles of an assistant and a tutor. It is also important that this software can provide tutoring help in simulation of a human collaborator. The strength of this methodology as compared to our traditional methods of science instruction is that it helps to integrate all modern educational technology resources in the same place (Leddo, 1997). Virtual reality is gradually becoming an important method in computer science instruction and has a direct application to teaching and training at many levels of education (Sims & Elson, 1997). Software for science instruction allows the penetration into nature through objects and scientific models and stimulates the curiosity and thinking processes, which are very necessary for developing students' creative skills. For example, the software ìFlying through protein moleculesî of the University of North Carolina shows a good application which allows students to interact with large molecules and structures (Rheingold, 1991).

Examples mentioned above show that although computers and various software programs can be of great aid for science instruction, there are some essential methodological problems related to their application in classes. Thus it is important to consider further research in this area for both quantitative and qualitative approaches. By making these efforts, we can find answers relating to better development of knowledge and skills in students .

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Theory in Search of Technology: The Inventive Model of Learning as a Basis for Teaching Science and Developing Software

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Computer Assisted Instruction (CAI) covers a myriad of different programs. In the area of science education several types of CAI are being used including: drill and practice, dialogue and tutorial, simulation and modeling, "lab" data gathering/analysis/ processing or microcomputer based laboratory (MBL), telecomputing, multimedia/hypermedia, and expert systems.

A review of the literature suggests that CAI studies in science education can be divided to two main groups; comparison studies which try to compare CAI method with traditional methods, and cognitive processing studies which focus on "how CAI affects learning processes. Early studies in the field focused on comparison of different kinds of CAI with the traditional method. However, it was concluded that CAI could no more be evaluated by a single outcome study as all textbooks, lectures, or films can be judged on the basis of a single comparison. "To draw general conclusions, it is necessary to take into account the results from a variety of outcome studies carried out in a variety of settings under different circumstances." (Kulik, Kulik, & Shwalb, 1986, p. 236). Comparison studies, even in the meta-analytical form, can not tell us why students learn better with CAI than with traditional methods. The novelty of using the computer may be one factor. More research is needed that focuses on identifying the characteristics of effective software and the conditions for its effective use.

Studies comparing computer-based learning with non-computer-based approaches do not necessarily provide a link to or understanding of what is going on while students are learning using instructional technology. (Berger, Lu, Belzer, & Voss, 1994) Even the best pre-post and randomized designs cannot answer such questions. Although meta-analyses provide an overall average measure of how computers affect learning, they cannot provide some of the specific information indicating how certain programs have affected the learning process and the specific contexts in which CAI programs were successful. Most meta-analysis studies showed that the most effective type of CAI in science education are simulations and MBLs (microcomputer based experimentation)(Berger et al., 1994). However, not all meta-analysis studies showed the same results, sometimes they were contradictory. That is why there has been a shift in the kinds of questions asked in more current research. As Mayer (1977) noticed "The traditional question concerning the effectiveness of one medium over another proved to be an unproductive question, as have previous studies on media effects." (p. 17) In most recent research studies the main questions asked are, How CAI can affect learning and do media influence students' learning? or, as Clark (1983) has suggested, do media merely influence the way learning is delivered?

Generally, CAI programs have had positive effects on student achievement. However, these effects have been less than expected by their creators. Furthermore, the implementation of CAI in the school systems has been too slow. According to Baker and O'Neil (1994) reasons for this slow implementation and the lack of good quality educational software can be attributed to three major sources. First, CAI has not been embraced and pulled by real needs of the school system because institutional focus has been on maintenance of existing goals. Second, with few exceptions, serious commercial developers, inhibited by their own short-term expectations for profit, have rarely targeted education. Third, the poor quality of the available educational software is due to the lack of a theoretical framework in the design of the software and other technical weaknesses in the developmental process.

Historically, the focus of research, and goals and methods used in the field of education software development have been highly related to the advancement of technology, the societal situation and the dominant learning theory. With each advance in technology there has been a concurrent shift in CAI research. Similarly, the evolution of learning theories from behaviorism, through

the discovery approach, then information processing, and now, constructivist teaching has produced new approaches in research and instruction.

Theoretical bases of the shift in CAI studies

It is now widely recognized that science education has failed to provide the majority of students with a real understanding of science concepts. Thirty years after Bruner (1960) introduced his cognitive approach in science and mathematics teaching, a large body of research has indicated that there is an urgent need for a new approach to science education. (Steen, 1987; Lochhead, 1983; Trowbridge & Bybee, 1990; Kruger, Palacio, & Summers, 1992).

Jerome Bruner's book *The Process of Education* (Bruner 1960) presented a theory that changed the whole system of education, especially in North America. Theoretically, the discovery approach or direct experience was supposed to be effective because students would do their own scientific processing.

In the 1960s, it was assumed that if the structure of the discipline was taught with an emphasis on inquiry students would not only learn the content and inquiry skills but would use and apply them to everyday life and to the problem solving in general. (Yager & Tamir, 1993, p. 638)

The most obvious drawback to the discovery learning approach is the amount of time required for students to make discoveries. Some educators (Mestre, 1993; McDermott, 1984) have suggested that it is necessary to reduce the number of topics in the school curriculum in order for the discovery approach to be effective. Given the amount and complexity of information, new fields of knowledge, and the realities of the information revolution brought about by information technology, this solution is impractical. Science education is not limited to traditional classroom instruction. For example, in distance-learning programs, student learning usually takes place away from the host institution. Today, a large amount of information is delivered outside of the school system through information technology such as television and the Internet. On the other hand, if educational systems make use of new models of meaningful teaching and learning, there would be no need to reduce the number of topics taught in schools. With the right approach, large bodies of knowledge could be learned in meaningful and effective ways.

Skinner (1968) queries how a teacher can arrange lessons so that every student makes discoveries. The quickest students in a class are likely to find solutions first; while the other students would simply copy the leaders. Therefore, less capable students may feel discouraged and lose interest. Also, interpersonal problems may arise as a result. That is why teachers have reported that the discovery approach has been boring for some students (Thijs, 1992). After all, can one be sure that the students who answer the teacher's questions have really discovered the information or did they know it already. Moreover, answering the teachers' questions based on hands-on activities and even solving the related problems, does not guarantee that the concepts have been understood.

Another problem is that discovery learning may not be appropriate for all students. Some students do not have the patience to try different approaches to solving a problem, especially without receiving feedback from the teacher. Other students are not sufficiently motivated to function well in a relatively unstructured situation. Students who are highly anxious or compulsive succeed in more teacher-directed classes (Hamachek, 1987). Furthermore, students may lack the prerequisite skills or self-confidence to make discoveries on their own. This is in harmony with some findings indicating that a learner controlled program is less effective than a computer-controlled program in computer assisted instruction at elementary level (McNeil, 1991). Therefore, a more active role on the part of the teacher or through computer-assisted instruction may be necessary.

The discovery approach or the inquiry method is useful as a valid and comprehensive, evaluation of students' misconceptions. It is also very useful to show the students how their preconceptions are in conflict with scientific realities. However, this is only one step towards meaningful learning. Prior to discovery, the teacher should introduce the objectives of the lesson so that students can be shown where to focus their attention. This requires a bridge between prior knowledge and the content to be learned.

Ausubel (1968) developed a theory of meaningful reception learning called the subsumption theory. The main idea was 'how does a person's prior knowledge and its organization (constructs) determine learning'. Ausubel had two major contributions to the development of cognitive psychology. First, his focus on the importance of prior knowledge and the construction of knowledge which lead to constructivism; and second, the introduction of the concept of advance organizers (AOs) as a bridge between prior knowledge and the content to be learned.

Advance organizers are superordinate concepts within which learners can subsume the new material and relate it to what they already know. Students often have no knowledge about a topic. Organizers are introduced in advance of the material to be learned, and are presented at a higher level of abstraction, generality, and inclusiveness (Good & Borphy, 1990). Advance organizers are not conventional previews or summaries that briefly state the main points in a presentation. They constitute a set of ideas that act as a framework to which the student can logically anchor subsequent related learning (Bowd, McDougal, & Yewchuk, 1994).

As already mentioned, the discovery approach proposes that direct experience is the best way to change students' misconceptions. It assumes that students will see the difference between their preconceptions and the physical

realities and hence, alter their preconceptions. The discovery approach assumes that the conceptual structure of science is based on the generalizations from data obtained in hands-on activities. However, it has been reported (Neressian, 1989; Grayson & McDermott, 1996) that even if students recognize a conflict between their expectations and the data, they will often try to discount the data. Therefore, their underlying, often incorrect belief is retained, or even reinforced. Moreover, inspection of the transcripts of students' discussions in the science classroom fails to show dramatic moments of conversion (Thijs, 1992). Based on the above findings, it would appear that an alternative approach to science teaching is needed.

Recent findings in cognitive learning suggest the need for a more systematic and comprehensive study of the students' prior knowledge and misconceptions. Given teacher training and teaching constraints, it is highly unlikely that a traditional classroom teacher could perform such a systematic analysis. The inventive model of teaching may solve this problem.

The inventive model is a new model for conceptual change based on the advantages and limitations of the approaches discussed above and recent research in science education. This model can be considered as a constructivistic model focusing on students' misconceptions and conceptual change. It provides a useful theoretical framework for technology-based instruction.

According to the inventive model, identifying student's misconceptions is not enough. It is more important to identify the underlying conceptions by exposing students to multiple problem situations. This systematic analysis of students' misconceptions can, and should be done, by computer. In fact, it is difficult, if not impossible, for a teacher to do such a systematic study of students' prior knowledge and misconceptions given class sizes and time restraints. Phase I of the inventive method begins with the systematic analysis of students' preconceptions in a particular topic.

Phase II introduces the content to be learned, in order to bridge students cognitive structure with the new content. These advance organizers can include concept maps and simulations, and/or interactive videos.

Phase III is the essence of this model. The purpose of this phase is to give the students the opportunity to:

Test their preconceptions through hands-on activities or computer based simulations. Articulate and become conscious of their own thoughts by making predictions based on them.

Compare their pre-conceptions with the scientific reality and identify the conflicts between their misconceptions and the scientific realities.

Becoming dissatisfied with their misconception through a multiple problem situation and feel the need for a new concept.

Explore plausible alternatives by themselves or as suggested by the teacher and choose the more convincing alternative.

In Phase IV, the final phase, the teacher provides the advantages of the scientifically acceptable conceptions through a multiple problem-solving situation.

The inventive model provides powerful learning opportunities for students but can be extremely demanding on teachers; therefore, a method must be found to encourage teachers to use it. New instructional technologies have proven to be effective in many constructivist teaching situations. However, more sophisticated technologies must be developed to fulfill the requirements of the new inventive approach to science education.

The new trend

Computers could be used in different stages of the inventive model. Thijs (1992), suggests that classroom experiments are never fully convincing since they can only be performed with imperfect results. Computer can simulate activities that are difficult or impossible to do in most classrooms. For example, it is impossible to eliminate friction and air resistance in a live physics experiment. With technology, "students are placed in a situation where they control an environment by interacting with the computer." (Carin, 1993, p. 313)

Computers might be used to simulate ideal situations as well as the abstract concepts and processes which are very difficult to grasp in reality. According to Grayson & McDermott (1996) computers combine the realism of animated motions with the idealizations of textbooks and lectures. Therefore, computers can be used both in evaluation of misconceptions as well as in other phases of instruction. Grayson & McDermott (1996) also noted that computer simulations are often much simpler to set up than laboratory demonstrations. Furthermore, a simulated situation is completely reproducible, requiring little intervention from the teacher. The same task may be presented in an identical way to every student.

Evidence shows that computer simulations are as effective as real experiments and save time. For example, McDermott (1984) observed that "the procedures the students used in typing to produce various motions in the computer environment closely resembled the procedures used by students in the laboratory investigations." (p. 30) Today, computers are considerably more sophisticated than when she made her initial observations in 1984.

Simulations follow the constructivist idea that learners construct their own unique concepts through active participation. Theoretically, students should be more mentally active in the inventive model. Simulations have great potential as a CAI teaching tool and are invaluable in helping teachers to design and conduct experiments more effectively and the pace of instruction can be adapted to the needs of the student. An important aspect of CAI simula-

tions is that the student must constantly be active answering questions, relating concepts to each other, solving problems, and making decisions.

Modeling software differs from simulation in that the learner is an observer of a phenomenon rather than an active participant. Modeling is also powerful in that it allows one to investigate processes such as following the steps in the working of an automobile or observing the movement of magma under ground and climaxing with the eruption of lava (Carin, 1993). Simulations and modeling are effective at enriching minds-on/hands-on activities and discussions.

Minds-on/hands-on experimental activities using a computer and sensor gather, process, and display data directly from the environment have been given the name microcomputer-based laboratories or MBLs (Carin, 1993) MBLs turn the focus away from mere trivial mechanical processes in laboratory activities to higher and more creative levels of scientific processes, that is, analysis, hypothesizing, and evaluating. With MBLs, data gathering/analyzing/processing is so easy that it motivates explorations and discovery. Students focus on thinking about data and not merely on gathering it. (Price, 1989)

According to Thornton & Sokoloff (1990) "There is strong evidence for significantly improved learning and retention by students who used the MBL materials, compared to those taught in lectures." (p. 858) It should be noted that they did not compare MBLs with real experiments in their study. However, they believe that MBLs allow student-directed exploration without the time-consuming drudgery associated with data collection. Time is saved for more observations and multiple problem solving situations, and data are plotted graphically in real time so that students get immediate feedback and see the data in an understandable form.

This is in clear contrast with the discovery approach in which students receive no feedback until the end of the lesson. Thornton & Sokoloff (1990), observed that the immediate feedback supports collaborative learning, and collaborative work provides immediate feedback. Furthermore, because data are quickly taken and displayed, students can easily examine the consequences of a large number of changes in experimental conditions during a single laboratory period. Thus, MBLs have the advantage of using probes to measure real-world physical attibutes, simulations allow effective control of the environment, and modeling allows one to see unobservable or time-constrained processes. It would appear that computers can be used effectively both in the first and the second phases of the inventive method.

Meta-analysis studies have shown that simulations and MBLs are the most promising applications of the computer in teaching science. These methods can discern and give guidance as needed so that students discover (construct/invent) as much as possible on their own. "Such techniques should foster the development of critical, original, and flexible thought. Microcomputers can be used by individual students to facilitate independent learning; some students can learn in one way and other students in a different way." (Berger et al., 1994, p. 487) The importance of cognitive style in learning is now well documented in the literature (Riding, 1997). Such instructional diversity is very difficult to achieve in a classroom setting, where the entire class is usually doing the same thing.

A detailed analysis of students' interactions with the computer (often by keeping log files of keystrokes and mouse moves) is an invaluable source of information on students' cognitive processes. Berger (1982) and Dershimer, Berger, and Jackson, (1991) have shown powerful learning curves and teaching efficiency in first-year college chemistry. They also discussed, how log files can be used to describe the learning and the process of estimation in a gamelike environment.

Mayer (1977) states that "Instructional development is too often based on what computers can do rather than on a research-based theory of how students learn with technology. In particular, the visual-based power of computer technology represents a grossly underutilized source of potential educational innovation." (p. 17)According to Mayer, computer-based multimedia learning environments provide students with the opportunity to work easily with both visual and verbal representations of complex systems. However, to fruitfully develop these potential educational opportunities, research is needed on how people learn with multimedia. He concludes that on the theoretical side, the results of an extensive series of studies using a variety of materials provide consistent support for the generative theory of multimedia learning. According to this theory, "coordinated presentation of explanative words and pictures is effective because it helps guide learners' cognitive processes." (Mayer, 1977, p. 17)

CAI also has the potential to facilitate 'learning how to learn' and has been used successfully for teaching problem-solving skills and cognitive strategies. Friedler, Nachmias and Linn (1990), used science software combined with MBL activities on heating and cooling to show that problem-solving skills or scientific reasoning can be improved (as measured by a "scientific reasoning test"). With increasing use of expert systems and artificial intelligence, it is proposed that conceptual maps could be designed with computers which have access to students' conceptual knowledge. Conceptual maps are strategies for conceptual change which can be used by teachers in all phases of the inventive model especially in the third phase.

In summary, the basic rationale of the inventive model is the belief that conceptual change does not occur simply because students see a conflict between their preconceptions and the scientific realities; rather, students, after testing their preconceptions will gradually realize the

advantages of scientific explanations. This will happen only if the teacher/technology supplies the required corrective feedback, and provides explanations of the advantages of the scientific conceptions through a variety of demonstrations. The effectiveness of different components of this model in science teaching have been well documented (Dykstra, Boyle, & Monarsh,1992; Berger, et al., 1994).

Hypermedia/Multimedia software development tools such as Authorware offer a unique opportunity for research in science education (Berger, et al., 1994). An integral part of instructional technology is the automatic logging of student actions. Combined with hypermedia techniques they provide important tools for testing this new model and for understanding the cognitive processes underlying the learning.

At The University of Calgary, the research team is investigating the effectiveness of the inventive model in teaching physics at the high school level using technology to support the learning environment. Computer-assisted instruction is being designed to fit the model—theory in search of technology. If the model is accepted, then perhaps teachers will utilize the technology.

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Multimedia Cases in Elementary Science Teacher Education: Design and Development of a Prototype

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This paper discusses the design and development of a prototype of a case-based interactive system, delivered via CD-ROM and the WWW for use in preservice teacher education. The development of this prototype has been conducted within the framework of the MUST-project (MUltimedia in Science & Technology). The MUST-project is a joint venture on behalf of three Teacher Education Colleges, the National Institute for Curriculum Development and the University of Twente in the Netherlands. The MUST-project aims at developing multimedia cases for the professional development of prospective teachers in elementary science and technology education. Multimedia cases are considered to provide a powerful learning environment that stimulates and facilitates the prospective teachers' reflection on learning and teaching. They consist of a combination of edited video-tapes of classroom events, as well as audio-taped information and text. The MUST developers employ an evolutionary prototyping approach, which combines input from theory and practice through the cyclic process of design, development and formative evaluation (in the field) of prototypes. This approach is facilitated, in part, by the authoring system used to create and revise prototypes: Authorware 4.0. This is a powerful, yet friendly tool which, for educational purposes offers two crucial advantages: a) educational experts (as opposed to ICT experts) can do the programming themselves, thus closing the communication gap between developer and programmer; and b) Authorware's flow-line authoring style makes it easy to cut and paste entire modules from one location to another, thus supporting true rapid prototyping.

In the next section, one of the main sources of inspiration for the MUST project is briefly outlined. Subsequently, the design and development of the prototype "Liquids in Test Tubes" will be further elaborated.

Cases and case based instruction: from linear structure via hypertext to hypermedia

Cases and approaches to case-based instruction offer curriculum materials and pedagogies to alter teacher education. Although they may be new to teacher educators, written cases and case-based instruction have been popular in professional development enterprises, such as law and medicine (cf. Lacey & Merseth, 1993). In general, cases bring the complexity of professional practice into educational programs, and thereby help to bridge the gap between theory and practice. Until now, the vast majority of cases for educational purposes have been given written form. They are crafted in compelling narratives with a beginning, middle and end, and situated in a specific event or in series of events (Shulman, 1992).

Written cases, however, are subject to a linear sequenced text structure. Hypertext, however, provides a nonlinear environment for organizing and displaying text. In such an environment, nodes of information are dynamically linked (McKnight, Dillon & Richerson, 1996). Stanton and Stammers (1990) give (partly empirically based) reasons why such an environment might be superior in supporting the learning process. They argue that nonlinearity:

- *adapts* to different levels of prior knowledge;
- *encourages* exploration;
- *enables* students to see a subtask as part of a whole task, and
- *allows* students to adapt material to their own learning style.

Hypermedia (or multimedia) can be perceived as an extension of hypertext. This concept refers to the integration of media such as audio, video, graphics, animation, spatial modeling and text, into one computer system (Cennamo, Abel, George & Chung, 1996; Jonassen & Reeves, 1996; Lacey & Merseth, 1993). Multimedia can stimulate more than one sense at a time and in doing so, may get and hold more attention (Jonassen & Reeves, 1996, p. 703). Particularly in teacher education, the use of video

recordings of classroom teaching in multimedia cases seems to be very promising, because they may capture the similarity of events occurring in classrooms with greater accuracy than written text: "a picture is worth a thousand words." Kinzer (1997) paraphrased this maxim by saying that in order to capture the complexity of teaching one needs a thousand pictures.

Jonassen and Reeves (1996) have developed convincing reasoning as to why computers (and thus multimedia) should be perceived as cognitive tools for educational purposes. These tools refer to technologies that enhance the cognitive powers of human beings during thinking, problem solving and learning. In multimedia-based cognitive tools, information is not encoded in predefined educational communications that are used to transmit knowledge to students. Rather, such multimedia productions intend to actively engage students in creating knowledge that reflects their comprehension and conceptualization of information and ideas. In this way, multimedia cases fit into a constructivist vision of learning.

From this perspective, multimedia cases offer ample educational advantages for (prospective) teacher learning (Bliss & Mazur, 1996; Cennamo et al., 1996; Fitzgerald & Semrau, 1996, Harfield, 1996; Nicais & Barnes, 1996) as they:

- *Stimulate* an active learning attitude in a learner-controlled environment;
- *Yield* the possibility to revisit classroom events in order to make sense of them;
- *Show* the cases from myriad perspectives;
- *Offer* procedural support for instructional design and classroom teaching;
- *Lessen* the gap between theory and practice, by giving practice a more profound and integrated position into teacher education programs.

Design considerations and decisions

In this section, the design considerations and decisions underlying the development of the MUST prototype are outlined. Beginning with prior commitment to case-based instruction, the aims and functions of the MUST cases are described; and finally, the design choices are presented.

Prior commitment

The MUST project's prior commitment to case-based instruction impacts subsequent decisions about more precise characteristics of the cases. In the MUST-project, the cases are *examples* (cf. Merseth, 1996)of more constructivist classroom practice in elementary science. To avoid any misunderstanding, these examples are not meant to be followed uncritically. On the contrary, they intend to stimulate reflective thought and communication. The cases are being designed in such a way that they provide ample opportunity for *analysis* and *reflection.*

The cases are "layered", which implies that different perspectives, in the form of additional information regarding the actual classroom teaching and comments, are in included. Comments are particularly meant to bring about an internal cognitive conflict (Levin,1995) and so stimulate students to in-depth processing of the information presented in the case.

Aims and functions of MUST-cases

The aims of the MUST-cases are to stimulate prospective teachers' pedagogical reasoning in elementary science and technology by situating learning in the complexity of classroom teaching. It is hoped that, through context-rich case descriptions, prospective teachers will be more able to construct and reconstruct their knowledge base by means of personal and collaborative reflection in a community of practice. In other words, the cases intend "to foster the three Cs: complexity, constructionism and community" (Lacey & Merseth, 1993, p. 547).

The MUST cases intend:

- *to demonstrate* exemplary practices in a realistic context;
- *to stimulate* reflection on pedagogical content issues;
- *to support* the design and implementation of high quality teaching;
- *to provide* a communication system for the exchange of ideas.

Design choices

McKnight et al., (1996, p. 630) suggest conceptualization of usability issues underlying the design of hypermedia systems in terms of four basic factors: the users, their tasks, the information space in which the task is being performed, and the environment or context in which all these interact. Application of their suggestions to the MUST-project leads to the considerations presented below.

Users. In a multimedia system for teacher education, two user groups are to be distinguished: the teacher educators and the students. The computer skills in both groups vary from hardly skilled at all to very elaborated. This implies that the interface of the multimedia system must be very easy to handle without boring the more experienced users.

As far as the teacher educators are concerned, it must be recognized that there are differences in beliefs about quality science teacher education and science teaching. The MUST-project favors flexibility of use of the multimedia cases and does not want impose a prescribed path on teacher educators (or prospective teachers). However, this flexibility of use has its boundaries, as the full educational potential of the multimedia cases will only reached in a constructivist learning environment.

As far as prospective teachers are concerned, the MUST-project intends to develop multimedia cases that can offer a challenging learning environment for students just starting

the teacher education program, as well as for more 'mature' students.

Tasks. For teacher educators, the use of multimedia cases will require a change in their current practice. Teacher educators need to act as coaches of the students, and take their ideas as a starting point for the learning process. The MUST-project intends to support teacher educators by means of workshops and written guidelines to be created based on the implementation experiences of the teacher educators involved in the project.

To support the flexibility of use by both teacher educators and students, different types of assignments are incorporated into the cases. Similarly, the system offers flexibility in that the teacher educators are free to add assignments (related to the cases) within the program.

Information space. Actually, the question about the information space refers to the boundaries of each case. In the MUST-cases, a distinction is made between the CD-ROM-component and the WWW-component. As MUST strives to incorporate the ideas of users, a WWW-component serves as a "boundless" information base, to which MUST users may contribute their suggestions for activities, additional cases and practice work. In addition, the WWW user has access to a broad domain of information via additional Internet links. The CD-ROM-component of the information space is limited to what the designers put into case, but has the advantage that it may be run locally (regardless of whether or not an Internet connection is available at the moment). In addition, this also omits the difficulties associated with (memory intensive) video fragments having to be downloaded from the Internet. On a CD-ROM, they may be accessed quickly and easily.

Context. Large-scale reform of Dutch elementary teacher education has been planned and partly implemented by the Ministry of Education. An important aspect of this reform is to stimulate self-directed learning of students, both individually and collaborative. Within this context, the Dutch government advocates the use of multimedia. However, policy regarding the integration of media in teacher education programs remains sketchy, to date. So, the MUST-project may also be able to contribute to a greater clarity in terms of the possibilities and limitations of multimedia cases in the larger scale reform of teacher education in the Netherlands.

Description of the MUST prototype

In order to facilitate a better understanding of the MUST project, a description of the prototype itself may be useful. Entering the program, users encounter the opening screen (Figure 1) which illustrates how this prototype will be integrated into the whole program.

At this stage in the MUST-project, the users have one option, to choose "Liquids in Test Tubes." This is the case that is being used for prototype development and evaluation.

Figure 1. Opening Screen

After this choice, the users enter the main menu of the case selected, (Figure 2).

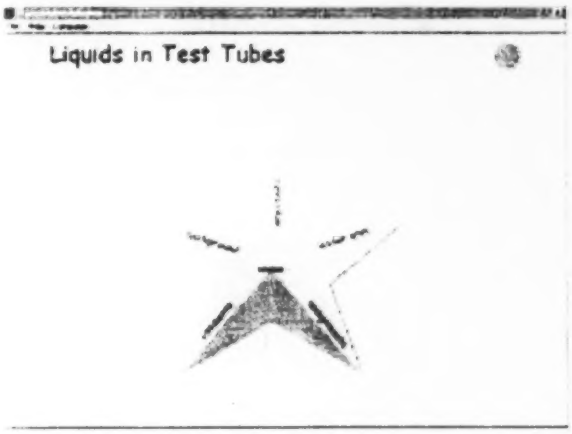

Figure 2. Main menu for the case

A star has been chosen as a metaphor for the interface, because it represents the nonlinearity of information. Additional reasons include the notion that "stars" are part of the science curriculum, and they are associated with "brightness." Clicking on the sun in the right corner of the screen gives the user access the MUST WWW homepage (http:\\www.to.utwente.nl\crc\mustweb).

Placing the video clip at the heart of the star emphasizes that actual classroom teaching forms the core of the case. (Due to budget constraints it was not possible to incorporate a new video into the current prototype. Instead, an existing video clip was used, originally developed for inservice education purposes).

By clicking on the word, "video", the user enters the screen pictured in figure 3.

The user may view the entire clip (17 minutes) from start to finish, or skip through sections by clicking on the particular lesson stage s/he is interested in.

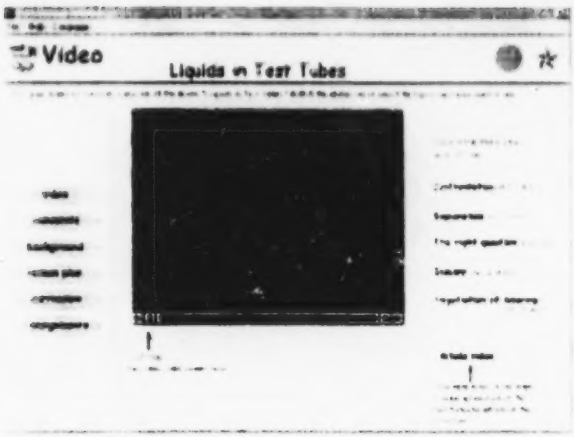

Figure 3. Video

Background information is presented in order to contextualize the classroom lesson (see figure 4). This background information intends to help the user to interpret the video. It provides factual information about the school, but also about the school's educational philosophy. The teacher page includes information about that teacher's view on student-centered elementary science. The class page contains some general information as well as authentic student work.

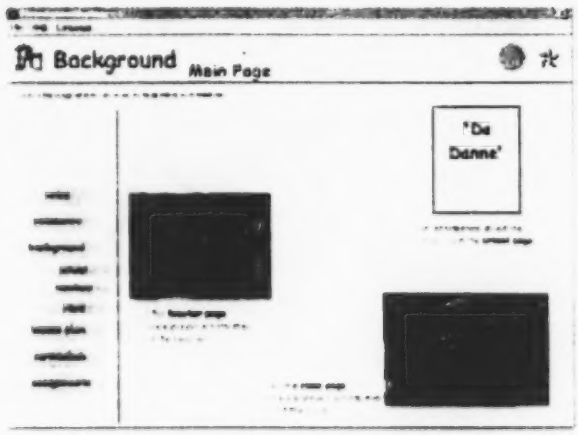

Figure 4. Background information

On the commentary comments screen (see figure 5), users may view and hear comments from various sources The comments are given by the teacher in the video, by science teacher educators, generic curriculum specialists, and also by prospective teachers. These comments may perplex students because differing views on the same lesson are expressed. By adding this type of information, the design team intends to encourage the users to formulate their own view on the lesson, as well as to reinforce the notion that there are no "right answers" when it comes to making classroom decisions.

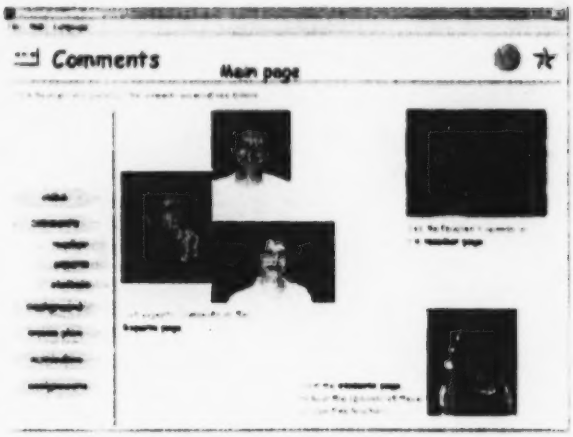

Figure 5. Commentaries

The assignment component offers various forms of assignments created for the future teacher; the typology used is as follows: meaning, critical and practice. The "meaning" assignments ask users to formulate the way they comprehend the information presented in the case. These assignments may be especially appropriate for prospective teachers in their first year of teacher education, because at that time they have little practical experience. In the "critical" assignments, users are stimulated to reflect upon the information presented in the case and to formulate their own opinions about strengths and weaknesses of the lesson, why the teacher made certain decisions etc. In the "practice" assignments, the users are asked to take action, by developing and implementing their own lessons.

Figure 6. Assignments

The users may also study and print the lesson proposal upon which the video was based. They have three options: the complete proposal, a brief outline and they may assemble a "tailor made" (custom) proposal.

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Finally, the curriculum area illustrates how the lesson used in the video case fits into a complete lesson series, and into the Dutch national curriculum for elementary science.

Final remark

The MUST design team has experienced the design and development of a prototype to be a professionally rewarding enterprise. They would recommend to others intending to design multimedia to begin the prototyping phase(s) as soon as possible. Not only have concrete prototypes aided in the formulation of our main objectives, but actual prototypes have served to severely enrichen the level and content of our design team discussions. Moreover, concrete prototypes (demos) provide an excellent means to communicate the (often otherwise abstract) aim of the project with others, such as sponsors (!) and intended users.

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Virtual Interns In The Field: Pre-Service Educators As Online Mentors To At-Risk Middle School Science Students

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The World Wide Web has become a popular Internet technology for use in the classroom (Quinlan, 1996). Graphical browsers, such as Netscape or Internet Explorer, provide students and educators with simple "point and click" access to numerous types of online resources, including networked databases, publications, multimedia files, and various discourse media.

Of this last type, electronic mail is perhaps the most widely used. An asynchronous system, e-mail does not require message sender and receiver to be online at the same time, and numerous studies have noted that this technology can be used successfully in the classroom. Pitt (1996), for example, found that frequent use of electronic mail as a means for submitting undergraduate assignments facilitated assessment and improved class discipline. Anderson (1996) indicated that email was effective in managing group projects. Others have noted that the technology could be used effectively to build collegial relationships. Tannehill et al. (1995), for example, found that email was an efficient medium for exchanging information between doctoral-level physical education students and in-service physical education teachers.

A newer, related technology, computer conferencing, has also been found to benefit students and teachers in instructional environments, especially in writing-intensive courses (Essid, 1996). Like e-mail, computer conferencing is asynchronous, but the technology allows users to post messages in "threaded" discussion forums—centralized bulletin boards that group or "thread" together messages of similar content to provide a visual heuristic to the user. Another key difference is that most computer conferences require the user to come to the designated "board" or "news group" and post the message, instead of the message being sent to individual users via e-mail and list-serv. Shriner and Rice (1996) has indicated that this increased convenience of access has facilitated the acquisition of undergraduate composition skills. Yeoman (1995) found similar results for students involved in collaborative writing projects. Other studies have noted improvements in moral reasoning (Harrington & Quinn-Leering, 1996), oral presentation skills (Anderson, 1996) and critical reflection (Harrington & Hathaway, 1994).

Several studies have indicated that computer conferencing technologies can effectively build and sustain mentoring relationships; however most of these studies examined mentorship of undergraduate-level students by working professionals. Oneil and Gomez (1996), for example, found that conferencing software was useful to networking professional scientists with undergraduate science majors interested in a particular field. The working scientists answered field-based questions posed by students and critically reviewed assignments submitted via e-mail. In a similar study, Sanchez and Harris (1996) connected content experts with in-service school teachers to serve as consultants on student learning projects. No published studies were located on computer mediated mentoring relationships between pre-service educators and public school students.

The researchers intend to explore this under-investigated field using a new Internet discourse technology—world wide web based "chat." Unlike conferencing and e-mail technologies, chat systems use a real-time synchronous messaging protocol that enables users to "talk" to each other by typing; dialogue appears as a screenplay, with user names highlighted and comments posted immediately adjacent. The researchers are interested in exploring the efficacy of this technology as it relates to knowledge acquisition, mentor relationship development, and concept visualization. Specifically, the following research questions will be addressed:

1. Does online mentoring facilitate the acquisition of science concepts (as perceived by participants)?
2. Does real-time chat technology facilitate the development of online mentoring relationships (as perceived by participants)?

3. What discourse patterns emerge as participants discuss visual scientific concepts using a text-based communication medium?
4. What topical patterns of content discussion emerge over time?
5. Are there any attitudinal changes among participants regarding their views of computer technology in the classroom?

Design and Methodology

Five undergraduates will be selected from an anticipated pool of 100 students enrolled in EDUC 204, an intermediate level educational technology course to be offered in the Spring of 1998. These students will be selected by the researchers based on written letters of application and screening interviews. The five at-risk students to be paired with the undergraduates will be selected by the researchers working in coordinated effort with Science teachers at Conway Middle School. It should be noted that one of the researchers is a University Supervisor to student-teaching interns of science at Conway Middle School.

Each of the five undergraduate mentors will be randomly assigned to one of the five at-risk students. Both mentors and mentees will undergo separate training, provided by the researchers on-site, in using the web-based chat system. Student mentees will use web-enabled computers available in the computer lab at their school. Mentors will use web-enabled computers in the computer lab at the CCU School of Education. For a period of six weeks, each pair of mentors and mentees will meet three times a week for 30 minutes in a preassigned virtual chat room accessible over the world wide web, password protected and unique to them, to discuss issues relevant to the student's science curriculum. Mentors will have been briefed during training by the normal classroom Science teacher regarding curricular content to be covered during the six week period. Mentors will use this information to anticipate some of the questions that may arise during the online sessions. At the conclusion of the six week period, all participants will be exit interviewed and surveyed; in addition, mentors and mentees will be introduced "for real" and debriefed at a social gathering on site.

Data Collection and Analysis

Traditional qualitative techniques (including pattern and cross-sectional analysis) will be used to analyze data accumulated during this study. Data sources will include transcripts of mentoring sessions and exit interviews of all participants (including host teachers), as well as completed open response item surveys.

Significance

This study utilizes an Internet technology that has previously been underinvestigated, perhaps because it is relatively new. Results from this study could provide valuable guidance for future studies investigating its efficacy in the classroom. In particular, it may facilitate the design of specific interventions to be used as independent variables in future quantitative studies with larger samples and achievement outcomes. The study is also significant because it targets a population of students (at-risk) who statistically have limited access to these advanced technologies and underperform in math and science curricula. Study findings may indicate teaching strategies that increase students' probability of success in scienceFinally, the study has implications for guiding future research in distance learning applications, where remote or virtual contact with instructors is an essential part of distributed curricula.

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TAMID: SCIENCE TEACHERS ON-LINE

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Based on information and communication technologies TAMID (A Hebrew acronym for "Communications, Science, Knowledge and Teaching"), operating at the Open University of Israel, has developed a combined learning, training and support environment for the benefit of junior high science teachers aimed at improving the standards of science and technology teaching in junior high schools.

The model and methodology developed in the project are applicable to non-science teachers, and other professionals. Thus TAMID can serve as a model for information and communication-based training and support for the advancement of professional performance.

Answering professional needs of teachers via computer technologies

Interviews with teachers and teacher-training professionals, and a review of the literature, reveal the following needs of junior high school teachers:

- Opportunities to consolidate, refresh, expand and update scientific knowledge.
- Continued development of teaching skills - both general and specific to science teaching.
- Exposure to different teaching styles, classroom experiences, professional dilemmas, and available resources.
- Access to expert support in the fields of education and science, and constructive opportunities for dialogue with experts and with colleagues.
- Feelings of mutual commitment and professional responsibility through the sharing of information.
- Access to relevant information and contact with research and development facilities, as well as technology-based industries.
- Assistance in adapting to the new science and technology curricula being introduced in Israeli junior high schools.

In response to these needs, a learning and support system was established. This electronic teacher center offers a range of on-line courses. Topics are drawn from the Syllabus for Science and Technology in Junior High Schools, and virtual classrooms are the point of contact. For the most part, activities which take place in this part of the center are initiated by TAMID. These include:

- Course assignments, comments on the assignments, discussion of teaching methods for material covered in the course, and clarification of material covered.
- A team of experts, representing all the relevant disciplines, both scientific and educational, at the teachers' disposal on the network, responds to questions submitted by teachers and provide professional and educational support.
- Discussion groups, which permit the teachers to converse with both colleagues and instructors in the exchange of relevant information.
- A database containing suggestions and ideas for classroom activities submitted for the most part by the teachers.
- A scientific news corner in which the teachers and experts can reflect upon scientific news and developments and how to integrate them in the classroom.

At present, more than 200 teachers participate in the program, learning and communicating on-line with tutors and experts.

Electronic teachers' center-The components: Learners, instructors, courses, and technology

TAMID holds the promise of serving as an electronic teachers' center for all junior high science and technology teachers. It offers a range of on-line courses on various topics in science and education, and ongoing support relevant to the teachers' day-to-day challenges and experiences. The courses can be readily adapted to meet changing needs.

On-line Courses: Objectives, Methods, Content and Materials

TAMID focuses on developing flexible and dynamic on-line modules for in-service training courses in science and science education, aiming to cover all subjects in the new Syllabus for Science and Technology Teaching in Junior High Schools in Israel.

- Each on-line course consists (more or less) of the following components:
- A general survey of the main principles of the topic, plus notes explanations and relevant definitions.
- A list of key words (in Hebrew and English)

- Study aids, including written material, databases and Internet sites.
- A compilation of questions, activities and assignments for students, which will be continually expanded.
- A compilation of recurring questions on the topic.
- Discussion groups which will clarify the topic and how to teach it.
- A list of experts and teachers enrolled in the course.

Each course utilizes a combination of written, electronic and visual materials. Study materials include text books (i.e. selected passages from Open University study units), databases, videos (including programs broadcast on Educational Television and on the cable TV Science Channel), papers from scientific journals, and items on science which appear on television or in the newspapers. The challenge is finding the best possible mix of materials and taking advantage of the most suitable technological means to deliver them.

Each course has its own "virtual classroom", where materials and bibliographies are available and the discussions take place. On-line discussions develop between the teachers and tutors in response to assignments, meetings, and issues that arise in the classroom, or items which appear in the media. Invoking participation on the side of the teachers is an issue in itself.

Courses are modular and adaptable, and can be linked to one another. Units developed for one course can fit and be integrated into another. Courses include team assignments, which are a combination of subject matter and pedagogical tasks.

In most cases, the assignment produces ideas for classroom applications of the principle being studied. These are added to the "Bank of Ideas" and circulated to all the teachers in the group. Face-to-face meetings are held about once a month and are devoted to hands-on laboratory work, field trips, guest lecturers, and discussions. These meetings play an important role in helping the group coalesce and develop mutual responsibility. Groups of teachers from the same part of the country meet locally. Satellite and video-conferencing are also being considered, particularly in the recruitment of lecturers.

In addition to the formal course components, teachers take part in informal discussions, which include current events, teaching strategies, motivational projects, and alternative evaluation methods. In this way, the learning process becomes both practical and relevant, allowing individual and general needs to be addressed when they arise. Teachers also submit questions on specific scientific issues to academic experts. These questions and answers are currently being edited, catalogued and listed according to keywords, and are to be added to the network as a resource for all teachers.

All the classrooms are open to all the teachers participating in the program. Thus students from different courses may "drop by" and get a taste of the material or participate in some of the discussions going on. This is expected to have certain drawbacks, primarily "interference" on the part of the "guests". If such interference becomes a real problem, we will revert to a system of "closed" classrooms.

A great deal of thought goes into planning and developing the courses. As our experience grows, so too do the issues: What do teachers need to know in order to teach? How can this knowledge be passed on to them? Many argue that teachers and students must be equipped to work in an information-oriented world where teachers are expected to guide and tutor rather than to simply convey knowledge. But what are the implications of this trend for teacher training? It suggests that learning should become more independent, and should be project-based and investigative. Turning the slogans into practical applications is no simple matter.

Until now, the main aim of all of TAMID's refresher courses has been for teachers to master a particular discipline, and the relevant teaching techniques. We believe that mastering the core of the subject matter enhances teachers' self-confidence and improves their performance, even in guiding projects. In any learning theory, it is the teacher's obligation to help their students understand the basic elements of a subject.

On-line Instructors

The educational and support team is composed of instructors, outside experts and colleagues:

- Instructors plan the course, prepare and mark assignments, lead on-line discussions with the teachers and offer suggestions and ideas for classroom activities. They are linked to the network and thereby maintain continuous contact with the teachers, answering questions as quickly as possible.
- The TAMID team includes a "representative" from all relevant disciplines, so the teachers have someone with whom they may consult on subject matter. This is particularly useful as the new science and technology curriculum sees science as one interrelated discipline, rather than a collection of subjects. Effective teaching requires that teachers work in teams within which there are different specializations, but this is not always possible within a single school. The chemistry and physics components of the curriculum are particularly problematic.
- The TAMID instructors hold regular discussions among themselves on the progress of their courses. Often these discussions take place on-line, putting into practice what TAMID preaches.
- Outside experts supplement the regular team of instructors and, when necessary, are called upon to answer specific questions posed by teachers. This gives scientists and experts on science teaching, who are

interested in being involved in education but have neither the time nor the forum, an opportunity to contribute to the educational endeavor

- Colleagues also fill an important role. Sharing ideas in real-time is an integral part of the TAMID approach, in which everyone (instructor included) learns from everyone else. As in "real" life, several on-line discussions are usually taking place simultaneously.

The Technology

We use the First Class software package (translated into Hebrew) for interactions and discussions and the Internet for information and data retrieval.

Issues in focus

Proper Mix of Applications

Lack of appropriate equipment at the teacher's site limits the ability to utilize the full potential of the technologies. By making more complete use of applications, such as sound, pictures, animation, video clips and link-ups to Internet sites, educational potential will be expanded. What is the "correct" combination? What is the connection between the new technologies and the cognitive functions involved in learning? What are the implications of these abilities to learning theories, and teaching methodologies?

Heterogeneity among learners

Teachers are by definition a group with varying levels of experience, ability, motivation, knowledge, and communication and thinking skills, their needs also vary according to the students they teach. Teacher training courses need to be tailored accordingly; a dynamic model, able to respond to their varied and changing needs, is required.

Databases

On-line databases are being put together which include a digital library, a bibliography of referrals to relevant Internet sites, and a record of activities on the network. Each database raises questions as to the type of material to be included, the quality of material and day-to-day management and organization.

On-line Instruction

Virtual tutoring is a new and not obvious task. On-line teaching is very demanding for the tutor. Many participants hesitate to express themselves for everyone to "see"; some are "over producers". Criticism and cynicism on the network are thundering, and so are silences. On-line teaching requires definition, training, practice and experience.

Technical Issues

In order to offer teachers readily available, nationwide technical support and inexpensive communications services, organizational and financial solutions must be found. Until then, achievements will be sporadic and with little influence.

Conclusion

TAMID offers a new model for in-service training for teachers based on information and computer communications, which is free of time and location limitations, and which is aimed at changing the way teachers prepare for their work.

The oft-repeated saying that teachers teach according to the way they are taught implies that teachers must be given a model for teaching that can be copied. But is this not deceptive? Can an average teacher in an average school attain the same standard of teaching as one in a center at which the best teachers teach with plentiful resources? A partial answer is that teachers should they be engaged in a constant process of learning and should receive support from a center which can offer expertise in all the required fields.

TAMID aims to confront these unresolved issues and to facilitate open debate on them among its staff and the teachers. Our hope is that what we learn through experience and deliberation will be of benefit to others with the same interest and goals.

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SIMULATION

Section Editors:
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The simulation section of the SITE annual appears to have always represented a smallish group of researchers. This year is no exception. Six papers were received this year for publication, from four different universities and a representative from industry. At the very least, this indicates that no single school or company can claim a monopoly on the research effort devoted to simulations. At the worst, it may indicate that simulations are yet to rouse widespread interest. As an optimist, my impression is that simulations will soon stake their claim as effective cognitive organizers and learning/teaching tools.

As this year's section editor, I had the distinct priviledge and opportunity to read all of these papers throughly. I find them to be of high quality, and worthy of each attendee's attention. Feel free to read these papers, attend the authors' presentations, make comments and take some of the authors' enthusiasm along home and share it with peers.

What follows is a very brief synopsis of the six papers and the last names of the authors. This year, the synopses are shorter owing to the presence of an abstracts book. If after reading a particular synopsis questions still remain, I encourage the use of the abstract book to clear them up.

The Papers

Kenton reported on the design and effect of a simulation used prior to formal instruction in middle school science. This simulation placed students into the role of simple circuit designers, attempting to make a bulb light with available materials. Students appeared to use the simulation to become aware of, or test their conceptions and thus to prepare for conceptual change.

Lewis investigated the use of a social studies simulation, in conjunction with World Wide Web resources, to produce an inter-disciplinary curriculum. Students would encounter the simulation in several classes, each emphasizing a different aspect of the program. Lewis' work involved the use of MECC's Yukon Trail simulation to interest students in the Yukon Gold Rush era.

Milbank describes the role of simulations in industrial training environments. The simulations described help to track the user's action throughout the encounter, and provide feedback to evaluators. This feedback helps to indicate weaknesses in the user's understanding of the phenomenon modeled.

Strang outlined the types of feedback available to students using the Teaching Decisions (TD) simulation. Students use the simulations early in their student teaching preparation. Different feedback types produced by the simulation are then used by preservice teachers to evaluate their performance in a simulated teaching environment.

Strang, Blackwell and Sullivan reported the effect of the Teaching Decisions (TD) simulation on the lesson planning abilities of users. The TD simulation provides feedback of various types to the user, who then uses the information to help plan a lesson.

Van Gorp described the use of a World Wide Web-based simulation of geometry with students in eighth grade mathematics courses. Teachers and students are able to engage in two-way communications, for the purpose of asking questions or submitting answers. The simulation models linear algebraic formulas of the type $aX + bY = c$, and plots the students' manipulations of the model.

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Preparing for Conceptual Change: A Middle School Science Electricity Simulation

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Physics is one of the subjects studied in middle school science that students find difficult to understand. Difficulties in learning may arise because students construct their own understanding about how the physical world operates based upon personal observation or experimentation (Hewson, 1984). Electricity is one subject of physics that students have difficulty understanding (Slotta, Chi, & Joram, 1995). As with physics in general, student conceptions about electricity are often a result of personal observation or experimentation. Moreover, these conceptions are often built upon ontological attributes, on which students later bases their beliefs about electricity (Chi, 1992). If student-constructed conceptions about electricity are not supported by or consistent with scientific theories of electricity, formal instruction about electricity may not be understood or fully accepted by the student (Slotta, Chi & Joram, 1995; Hewson, 1982).

The purpose of this paper is to describe the role of an electricity simulation in preparing middle school students for conceptual change in science. In this paper, current practices in science learning are presented, followed by an overview of the conceptual change theory. Then a definition of computer simulations and their characteristics that make them appropriate for constructivist learning are presented. Finally, a discussion of the Workspace simulation used to help middle school students become aware of their conceptions and prepare for conceptual change is presented.

Science Learning

Physical science content standards for grades K-4 involve learning in the fields of object and material properties, position and motion of objects, and light, heat, electricity, and magnetism. For example, the standards explicitly describe students coming to know how electricity may produce light, heat, sound, or magnetic effects (NSE Standards, 1996). In grades 5-8, students are to build upon this knowledge to explain the use of electricity as energy and the transfer of energy (NSE Standards, 1996).

A student may have developed strong ideas about scientific phenomena prior to learning about them in school. The strength and persistence of these ideas increase as the ideas are tested and verified by the person (Rumelhart, 1980; Meyer & Woodruff, 1997). Often when students' personally-produced ideas are tested under scientific conditions, they inaccurately explain the phenomenon (Hewson, 1981). Student-created ideas often persist despite formal instruction, even when formal instruction is intended to undermine a student's support of inaccurate ideas. Meyer and Woodruff (1997) reported that students often consider laboratory environments to be artificial and separate from reality; moreover, students believe their own ideas were created in the real world. That is, students often refuse to accept the evidence provided during laboratory experiences because the environment in which the student developed the conception (i.e. a students' personal observation) seems more real to the student than a science lab environment (Meyer & Woodruff, 1997).

Conceptual Change in Science Education

Posner, Strike, Hewson, and Gertzog (1984) described a theory (known as conceptual change) that examined the way students adopt or change their conceptions. The researchers suggested that the process of changing a person's conception takes place in four stages. The stages are dissatisfaction with a conception, intelligibility of the new conception, plausibility of the new conception, and fruitfulness of the new conception.

Dissatisfaction with a conception occurs when a student's existing conception is ineffective in correctly solving a problem. After several attempts to solve the problem with their existing conception, the student may become aware that the conception is unable to correctly solve the problem, and dissatisfaction with the conception is the result. After a student has become dissatisfied with an existing conception, he/she may seek a new conception that can solve the problem. To begin the process of conceptual change (the dissatisfaction stage), a student must be aware of their current conception.

Computer Simulations

Computer simulations have been used in all areas of science to enhance student learning. However, the instructional use of computer simulations to create environments for students to make meaning or test their understanding has been questioned (Thomas & Hooper, 1991). Purity of computer simulations to offer environments for students to become aware of and test their conceptions is discussed, followed by a description of Workspace and its use with middle school students.

A computer simulation can be defined as: "a computer program containing a manipulatable model of a real or theoretical system. The program enables the student to change the model from a given state to a specified goal state by directing it through a number of intermediate states. Thus the program accepts commands from the user, alters the state of the model, and when appropriate displays the new state"(p. 498) (Thomas & Hooper, 1991).

Thomas and Hooper (1991) defined a model as a set of parameters that control the process being modeled. As stated above, the system being modeled need not exist in reality (thus enabling the modeling of systems that are either too dangerous, expensive, or impractical to use in the classroom)(Gredler, 1996). Thomas and Hooper (1991) also described the existence of a given state and a goal state in a simulation. The given state introduces the problem to be solved, and the goal state is the desired result reached by manipulations of the model. Simulations are excellent agents for achieving transfer of knowledge (Thomas & Hooper, 1991), but are often used in instructional settings either to provide new knowledge or test previously developed knowledge (de Jong, 1991).

Purity is an important consideration when designing or evaluating the instructional uses of a simulation (Thomas & Hooper, 1991). Thomas and Hooper (1991) divided simulation models into two groups: pure and impure. The distinction between pure and impure simulations is categorical, based upon Thomas and Boysen's (1984) Taxonomy for the Instructional Use of Computers. The five categories of the taxonomy (experiencing, informing, reinforcing, integrating, and utilizing) are based upon the relationship of the student to the information being learned. Pure simulations were defined as those that place students in experiencing or integrating activities. Thus, pure simulations place students in models where information is encountered for the first time (experiencing), or as a method to determine how the student solves an unfamiliar problem using information given in a different context (integrating). Impure simulations deliver information to students (informing) or test their knowledge of previously learned concepts (reinforcing).

Pure simulations include activities that familiarize students with unfamiliar content, giving these students an opportunity to explore and develop conceptions about the content prior to formal instruction. Pure simulations also may provide students with an opportunity to demonstrate how they may have transferred conceptual comprehension from one type of activity to another. That is, the student may use (integrate) the knowledge they have gained in one context to solve a problem encountered in another context.

Impure simulations are those that place students in informing or reinforcing activities. The informing activities teach the student about the process being modeled. Reinforcing activities test the student's comprehension of information previously taught. Impure simulations seek to have students demonstrate their mastery of factual data, often within the same context that the material was learned.

Workspace

Workspace is a computer simulation of electricity designed for use prior to formal instruction about electricity. According to Thomas and Hooper (1991), Workpsace is a pure instructional simulation in that Workspace places users in and experiencing role with regard to electricity. Workspace places users into the role of a circuit builder (Figure 1). Middle school students used Workspace to develop or become familiar with their conceptions of electricity.

Workspace provides users with an environment to discover electricity concepts and to build or test their existing conceptions. By confronting a challenge to their existing knowledge base, users either affirm their beliefs about electricity (if the circuit functions), or develop a sense of cognitive dissonance (if the circuit does not function). This cogntive dissonance can become dissatisfaction if the student interprets the circuit design flaw to an existing conception that is no longer valid. A limitation of Workspace is its inability to place more than two wires into a single bulb circuit. Users indicated that they felt the experience was real (Kenton, 1997).

Figure 1. Workspace Project Window

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Workspace Data and Analysis

Workspace produces data of two types that may be utilized to assist identifying student conceptions regarding electricity: sequential mouse click record (adapted from Williams and Dodge, 1993) and screen captures made each time the student tests a circuit design.

Sequential Mouse Click Record

This record tracks each user's circuit building designs. Workspace tracks several pieces of information for each mouse click. Figure 2 illustrates a sample printout of a completed circuit. Each mouse click is recorder in sequence from first action to final action in numerical order. A report similar to the example shown in Table 1 is produced automatically by Workspace when the user exits the program.

Table 1.
Workspace Mouse Click Record.

Stack opened at: 9:30:08 AM on Friday, December 5, 1997

1,159.80,SimulationIntro,card field "IntroText",159.80,163,100
2,163.50,SimulationIntro,card button "Do a project!",3.70,160,128
3.00,165.95,Project Menu,card button "Do a project!",2.45,160,128
4,167.73,Project Menu,card button "One Bulb Circuit",1.78,158,68
5.00,170.65,Simple Circuit,card button "One Bulb Circuit",2.92,158,68
6,172.82,Simple Circuit,card button "Bulbs",2.17,416,212
7,185.80,Simple Circuit,card button "Wire",12.98,404,72
8.00,189.23,Simple Circuit,card button "Wire",3.43,160,157
9.00,192.60,Simple Circuit,card button "Wire",3.37,206,262
10,202.08,Simple Circuit,card button "Wire",9.48,390,70
11.00,205.80,Simple Circuit,card button "Wire",3.72,135,157
12.00,210.03,Simple Circuit,card button "Wire",4.23,85,263
13,235.95,Simple Circuit,card button "Test Circuit",25.92,303,306
14,244.58,Simple Circuit,card "Simple Circuit",8.63,303,306
15,284.48,Simple Circuit,card "Simple Circuit",39.90,303,306
Stack closed at: 9:34:57 AM
Total elapsed time= 288.93 seconds

From left to right on each line: (a) the number of the event, (b) the total elapsed time before the listed event, (c) the name of the card where the click occured, (d) the general location on the card of the mouse click (such as a button or field name), (e) the elapsed time between the previous mouse click and the current mouse click, (f) the screen x coordinate of the mouse click (measured from the left edge of the screen), and (g) the screen y coordinate of the mouse click (measured from the top edge of the screen).

To analyze the data recorded for each event, a separate data checking program is used. For example, the circuit recorded in figure 2 progressed from action 6 to action 13 where the circuit was tested. Action was a click on the bulb button on the right side of the screen (coordinates 416, 212). Thirteen seconds later, the user clicked on the wire button (coordinates 404, 72). The next two actions describe the locations of the ends of the first wire. The first end was located on the right terminal of the bulb, as placed in the center of the screen (160, 157). The second end was placed on the right terminal of the power source (206, 262). Nine and a half seconds later, the user repeated this process for the wire placed on the left side of the circuit. One end of the wire was placed at the left terminal of the bulb (135, 157) and the other on the left terminal of the poewer source (85, 263). Twenty-six seconds later, the user pressed the test circuit button, resulting in the production of a screen capture (Figure 2).

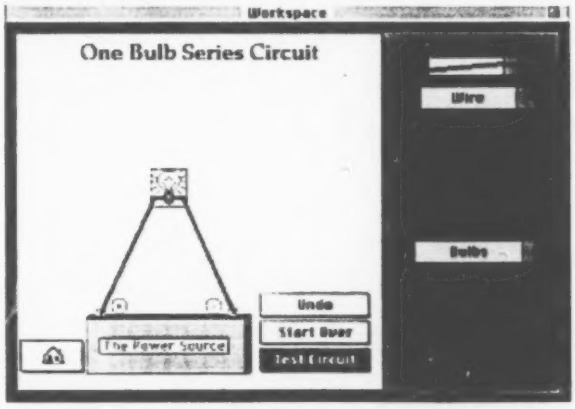

Figure 2. Workspace Sample Tested Circuit.

Screen Captures

Screen captures are graphical representations of the material on the screen. On Macintosh computers, the key sequence Cmd-Shift-3 will produce a capture of the entire contents of the screen. This file is systematically named "Picture xx" where the xx stands for an integer starting with 1, and incrementing for each successive screen capture. Numerous utilities exist that perform the same function on other computers.

Workspace captures the screen appearance for the instructor to be able to review the conceptions shown within the capture. These captures may be evaluated according to Shipstone's (1984) categories of electricity conceptions. However, screen captures alone may not fully convey a student's conception. Thinking-Aloud protocols, using snapshot data as discussion material, were more effective at revealing the student's conception than the snapshot data alone (Kenton, 1997).

Implications of Workspace on Middle School Students' Learning about Electricity

Although Workspace is a very simple simulation of electricity, the data-gathering ability is quite powerful in helping to determine each user's electricity conception.

Using Workspace's mouse click tracking records and screen captures were effective in identifying circuit design conceptions and strategies of middle school students (Kenton, 1997).

Thomas and Hooper (1991) and Hooper and Thomas (1990) reported that pre-instructional simulations are effective at acquainting or reacquianting users with their conceptions regarding the topic of study. This methodology was investigated by Brant, Hooper and Sugrue (1991) within lecture environments. Further studies are planned to assess Workspace's group use characteristics. These studies will investigate the effect of preinstructional simulation use and group discussions on student electricity learning.

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Developing Critical Thinking Skills through an Interdisciplinary Approach for the Use of Social Studies Simulations and the Internet in Upper Elementary School Classes

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This presentation will develop and evaluate ways to incorporate MECC's simulation software into the upper elementary curriculum through an interdisciplinary approach to strengthen the critical thinking skills of analysis and synthesis, particularly through the use of MECC's Yukon Trail. Activities will be demonstrated for use in social studies, mathematics, science, geography, literature and language arts classes. This approach may increase verbal fluency, vocabulary, and complexity in written expression as evaluated by writing assessments, such as the TCAP. Computerized simulations in multimedia, such as MECC's software, may increase motivation and may promote authentic learning in the classroom (Agnew, Kellerman, & Meyer, 1996).

Critical thinking requires thought to be analyzed and assessed for its clarity, accuracy, relevance, depth, breadth, and logicalness. Since reasoning occurs within points of view and frames of reference, students need to be aware of an author's approach to a particular problem, as well as their own. (Paul, 1997a; Biehler & Snowman, 1993).

An understanding of critical thought enables students to take basic tools of critical thinking they learn in one subject and extend them, with proper adjustments, to other subjects which they study. Students can be taught so that they learn how to bring the basic tools of disciplined reasoning into every subject they study (Paul, 1997a).

From the Critical Thinking Glossary come these important terms:

> "Analyze: To break up a whole into its parts, to examine in detail so as to determine the nature of, to look more deeply into an issue or situation. Students should continually be asked to analyze their ideas, claims, experiences, interpretations, judgments, and theories and those they hear and read." (Paul, 1997b)

> "Perspective (point of view): Human thought is relational and selective. It is impossible to understand any person, event, or phenomenon from every vantage point simultaneously. Critical thinking requires that this fact be taken into account when analyzing and assessing thinking." (Paul, 1997b)

A "strong-sense critical thinker is one who is predominantly characterized by an ability to question deeply one's own framework of thought, an ability to reconstruct sympathetically and imaginatively the strongest versions of points of view and frameworks of thought opposed to one's own, and an ability to reason dialectically (multilogically) in such a way as to determine when one's own point of view is at its weakest and when an opposing point of view is at its strongest." (Paul, 1997b)

Teaching for critical thinking enables students to explicate, understand, and critique their own deepest prejudices, biases, and misconceptions. Genuine fair-mindedness is achieved by developing critical thinking skills in dialog with others where they gain empathic practice of entering into points of view that students are fearful of or hostile toward (Paul, 1997b). Unfortunately, most assessments are based on lower-order learning and thinking. Chief culprits have been multiple-choice, machine-graded assessments which have focused on surface knowledge. Higher-order thinking, critical thinking abilities, is increasingly crucial to success in every domain of personal and professional life.

Research methodology: Approximately ten (10) public and private elementary schools, housing an approximate total of thirty (30) sixth grade classes, will be randomly selected from Metro-Nashville and surrounding areas. Of these thirty classes, ten (10) sixth grade classes, consisting of approximately 250 students, will be randomly selected

for the treatment group, while ten (10) sixth grade classes, consisting of approximately 250 students, will be randomly selected as the control group. Each of the 500 students will be administered both a pre-test and a post-test of critical thinking skills.

Students should be able to demonstrate the ability to "distinguish clearly between purposes, inferences, assumptions, and consequences; discuss reasonably the merits of different versions of a problem or question; decide the most reasonable statement of an author's point of view; recognize bias, narrowness, and contradictions in the point of view of an excerpt; distinguish evidence from conclusions based on that evidence; give evidence to back up their positions in an essay; recognize conclusions that go beyond the evidence; distinguish central from peripheral concepts; identify crucial implications of a passage; evaluate an author's inferences; and draw reasonable inferences from positions stated" (Paul, 1992; see also Biehler & Snowman, 1993).

Jonassen (1996) identifies databases, spreadsheets, semantic networks, content expert systems, computer-mediated communications, multimedia, and hypermedia as "mindtools", selected application programs for engaging and enhancing thinking in students. The computer application programs that Jonassen identifies as "mindtools" can be used to represent knowledge in a variety of subject areas; they are "generalizable" and engage learners in critical thinking.

Jonassen (1996) further states that effective simulations require well-structured activities, such as those outlined in this presentation. Critical thinking skills such as evaluating and analyzing can be engaged by information retrieval, particularly through research on the Internet. Critical thinking skills such as assessing and identifying assumptions can be engaged by e-mail, while computer conferencing (using LISTSERVs, bulletin boards and newsgroups) involves analyzing and evaluating the issues being discussed. Computer conferencing engages participants in elaborating on ideas, analyzing opinions and perspectives, and then synthesizing various positions.

MECC allows using their simulation software (Africa Trail, MayaQuest, Oregon Trail, Oregon Trail II, Yukon Trail) in a variety of ways (as a review of curriculum, individually or small groups, or as a reward). The intent of this paper is to show how to integrate the simulation into the curriculum in a number of different areas. (While MECC states that "gambling was omnipresent during the Klondike gold rush", for the educational purposes of this research the gambling aspect of the software will be disabled as per MECC's instructions. However, I do regret losing access to the two-team dog sled race in Sheep Camp, which would provide an entertainment side to the real thing, the annual Iditarod Sled Dog Race in Alaska.)

Language arts classes can use the computerized journal for writing exercises and reflections about research and readings done by the students in the class. One of the characters the students will encounter during the simulation (at Dawson City) is Jack London, the author. Students may appreciate the class time oral reading of his book, "The Call of the Wild". They may also enjoy the oral reading of Velma Wallis' book, "Two Old Women: An Alaska Legend of Betrayal, Courage and Survival."

Geography teachers may appreciate the map skills developed in the software program and through the readings of "The Call of the Wild" and "Two Old Women". These map skills can be applied to tracking (via the Internet's live coverage) the annual Iditarod Sled Dog Race. Mapping skills, strategy formulation, record keeping, and deductive reasoning are skills developed by game-type problem-solving programs and simulations (Biehler & Snowman, 1993).

Science teachers can review weather conditions for Seattle, Washington (where the journey to the gold fields begins), Skagway and Dawson, Alaska (some of the few cities of the region around the gold fields), and the Yukon Territory of Canada. The students can also monitor the weather (via the Internet) of the Iditarod race. Other projects of interest might include minerals (relative value of gold, silver, iron ore, etc.), mining techniques and methods (1897 compared with 1997), and materials and clothing production (1897 compared with 1997).

Math teachers could explore supply and demand economics(as supplies dwindle, prices increase). Distances between significant sites could be determined and the distance traveled each day in the Iditarod race could be charted.

Social studies teachers may want to use the K-W-L (know, want to know, and learned) strategy. The Yukon Trail software program lends itself to cooperative learning, as most activities are best accomplished in pairs, but group size may be adjusted based on the availability of computers. Since characters in the software program who have both a first and last name are supposedly real people, teachers could have the students research a particular character via print text and/or the World Wide Web,. The students could then give oral reports in their language arts classes about their chosen character. If done in pairs or teams, the group could provide posters and other types of visual presentations. Depending upon computer and software availability, multimedia presentations could also be accomplished.

A recent posting to the Listserv discussion list "Middle level education/early adolescence (10-14)" revealed that "in 1996, Internet access was available in about half (53%) of the schools in which 71% or more students were eligible for free or reduced-price lunch programs and in 58% of schools in which 31 to 70% of students were eligible. In comparison, 72% of schools with 11 to 30% of students

eligible for the free or reduced-price lunch program had Internet access, and 78% of those with less than 11% of students with free or reduced-price lunch eligibility were connected to the Internet." Therefore, recognizing that not all schools will have access to the Internet, the proposed activities will focus on both text-based documents (books) and web-based hypermedia via the World Wide Web (KIRK_WINTERS, 1997).

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Developing Simulation-based Aptitude Evaluation Tools: A New Aptitude Measurement Paradigm

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Simulation-based aptitude evaluation tools are a new type of psychometric device that takes advantage of the ability of high-powered desktop computers to simulate reality and to simultaneously measure the reactions of users of the simulation as they cope with scripted simulation experiences. Praxis Technical Group, Inc, a small Canadian company, has recently developed several such systems along with complex software for the development of these evaluation tools. These evaluation systems often provide extensive training to the user as a part of the evaluation process, and may, in fact, be used to develop certain skills and abilities in untrained users before testing for the acquisition of those skills.

Although the advantages of these new tools are considerable, their use is restricted to the measurement of abilities required in situations which are reasonably simple to simulate by computer. However, as the power of desktop computers has continued to dramatically increase, the ability to simulate a wider variety of events has grown proportionally. Thus, simulation-based aptitude evaluation tools are moving from a marginal and experimentally interesting measurement device to a potentially mainstream psychometric technique. New Java-based middleware will soon make it possible to train and evaluate teams of users over the Internet and to compare the abilities of team-trained users with those who do not have appropriate experience and skills in collective action. This paper discusses simulation-based aptitude evaluation tools, critical features of their design and construction, their advantages, and examples of their use.

Advantages and disadvantages of simulation based aptitude evaluation tools

The primary advantage of simulation based aptitude evaluation tools is that they provide a way of directly testing for specific skills and aptitudes with demonstrable high validity. This validity stems from the fact that performance is measured under circumstances which closely simulate the actual circumstances under which aptitudes or skills will be required, not from statistical inference. Furthermore, a properly developed simulation based tool will test actual performance of the required skills or aptitudes, and not abilities which are assumed to be analogous to, or which are assumed to occur in concert with the desired abilities.

Frequently the only alternatives to simulation based tests are pencil and paper tests for skills which are assumed to be analogous. These tests therefore often have questionable validity for the specific purposes to which they are put, simply because the assumption of an analogous relationship between the skills they were designed to test for and the skills desired may not be valid.

Furthermore, the high face validity of properly designed simulation based tools means that statistical validation over large populations is unnecessary. As a consequence, simulation based aptitude evaluation tools are not as expensive in comparison with other types of tests as they may initially seem. Even though simulation based tools are initially relatively expensive to develop, they are relatively inexpensive to validate. As a consequence, their overall cost is generally comparable or lower than the development costs of pencil and paper tests.

A secondary advantage of these evaluation tools is that they are completely computer-based and are therefore self-administering. As a consequence use of the tools is relatively inexpensive and trouble free and application of the tests is totally consistent. In normal use the test subject sits down to computer which gives all necessary instructions and required information through a multimedia computer-based training program. The computer presents the simulation as required, automatically observes the behavior of the subject, and at the end of the test sequence, the computer performs any necessary statistics on the collected data and presents a profile of the test subject.

The primary weakness of simulation based tools lies in the need to create a close simulation of the actual circumstances in which desired aptitudes and skills will be required. Even small differences may seriously hamper the

validity of the tests, or at least render that validity questionable to the extent that extensive statistical validation will be required.

How do simulation-based aptitude evaluation tools work?

Simulation-based aptitude evaluation tools use the power of computers to simulate situations in which specific skills, aptitudes or intellectual abilities are required. The use of these skills and abilities enables the user (i.e. the subject of the evaluation) to cause the simulated event to progress in a certain way. Users who lack the requisite abilities are unable to control the simulation in the desired way and thus develop an outcome which is easily distinguished from that developed by skilled users.

In practice, the presentation of simulated problem events and the tracking of the user's response to those events is completely automated. A complete evaluation generally consists of many simulated events, each one designed to elicit specific behaviors. Certain aspects of the user's response to each event in the series of presented events, trigger a monitoring system which records information in a database concerning the user's responses. At the end of a testing session, which may last several hours, the information collected in the database can be statistically manipulated (this is usually automatic) to develop a profile of the user.

Simulation-based aptitude evaluation tools have recently been developed and have been used to select candidates for such jobs as air traffic controllers, operators of computer-based process control systems, and similar jobs which require complex abilities and in which the incumbent employee will normally operate through a computer or a computer-like interface. However, simulations of business processes and other "soft" events such as negotiations, are raising the possibility of simulation-based evaluation tools for skills and abilities which do not normally involve computers.

A simulation-based aptitude evaluation system is considerably more than just a simulation. In fact, in some examples the simulator is the simplest part of the system. The essential components of such a system are as follows:

Simulation engine

The simulation engine is a mathematical or quasi-mathematical kernel which receives information from the event handler regarding the state of a number of variables (sometimes numbering in the thousands) and using that information and its own built-in mathematical structure, calculates outputs (i.e. new values) for all of the same variables. This output represents the state of the system at some future point in time. For example, the simulation engine which drives the simulation of a unit in an oil refinery receives information regarding the state of all the (simulated) devices in that (simulated)unit — the state of pumps, valves, levels in tanks, pressures in vessels, and so forth — as well as information regarding control moves establishing desired changes in values of variables representing the states of these devices. The simulation then calculates what the state of each device will be four seconds in the future (four seconds is the refresh rate of a typical refinery control system). It then transmits this information to the event handler.

Event handler

The event handler is more of a convenience than a necessity. It collects input from all sources and output from all sources and keeps this information segregated into its appropriate time steps. When any of the other components requires information or wishes to send information to another component, it does so through the event handler.

User interface

The user interface is the interface for communication between the user (subject, trainee) and the simulation system. For some kinds of simulations the user interface is a copy of the interface used in real-life. This is true of computer control system interfaces, air traffic control interfaces, and the like. Interfaces for other types of simulations are more problematic. Much of the initial or "face" validity of a simulation-based evaluation tool is intimately related to its user interface. If the interface and/or the means of manipulating the interface are not similar to the real-life task conditions for which aptitudes or skills are being sought, the validity of the test could be compromised. For example, instead of testing for skills necessary to control air traffic within a control zone, one might instead be testing for manipulative skills necessary for controlling a computer mouse. If mouse-using skills are among the skills necessary for an air traffic controller, then this is much less of a problem.

In many respects, therefore, the user interface is the factor limiting the effectiveness of simulation-based evaluation. One of the greatest advantages of simulation-based evaluation is its high face validity. If this initial validity is seriously compromised, the advantages of simulation-based aptitude evaluation may be lost.

C. B. T. system

The task of explaining the simulation based test and the collecting registration information is usually handled by a computer-based training program. Such programs are closely integrated with the simulation system, but provide information from a collection of multimedia files. Such programs may include short quiz sequences which ensure that the test subject understands critical information which may be necessary to his performance of the tasks required during the simulation sequence.

Communications system

Complex simulations may involve the simulation of communications between the test subject and simulated

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members of a simulated crew. For example, in a simulation of a unit of an oil refinery or chemical plant, one of the most important skills is the ability to communicate effectively with operators running other units and with operators working outside in the plant. Furthermore, the simulation system itself may from time to time be required to communicate with the test subject. All these communications may be done by selecting text items from pop-up boxes on the screen but it is questionable that the ability to select appropriate text is the same as the ability to communicate effectively by voice.

Recently, Praxis Technical Group has been experimenting with computer voice recognition and it is reasonable to say that voice recognition techniques have matured sufficiently in the last year that two-way communication with a computer by voice is now a possibility. As a matter of fact, this entire paper was dictated to a computer and converted into text by a voice recognition program.

Data collection system

A simple database is set up so that registration information and evaluation information can be collected. In effect it matters very little what type of database is used. Data is collected from the event handling system. It is usually marked for collection by the scripting system.

Scripting system

The final and possibly most important component of a simulation based aptitude evaluation tool is a scripting system. The purpose of the scripting system is to control the simulated experience in order to provide test sequences which will elicit behavior for the evaluation tool to measure. Scripts control all aspects of the simulated environment to produce "scenarios" – chains of events which mimic real-life situations. These scenarios are generally half an hour to an hour in length, but may be much longer.

In practice, scripts not only control the simulation engine, but watch for specific behaviors and control the data collection side of the system. For example, a script may cause a pump in a chemical plant simulation to shut down. The simulator will then react in a way comparable to the actual plant. The script system will "watch" the test subject to see if he/she performs the right moves to select, set-up and activate an alternate pump. If the test subject performs correctly, evaluation scores are written into the database. If the subject is only partially able to restore the simulation to normal operation, the script may record appropriate marks or comments and then may restore the simulation to correct operation and at the same time launch a computer-based training program which explains to the test subject what ...s happened and what the new situation is.

The scripting system is the most complex part of a simulation based aptitude evaluation tool. Praxis software developers have found it necessary to develop a special scripting language which is both fully conditional and fully parallel. It was also necessary to develop a special compiler and debugger. The need for a scripting language with these characteristics occurs because it is not always possible to know in which order things will occur, nor exactly how they will occur. Both the user and the simulation engine will react in unique ways to a situation as it unfolds.

As a consequence the scripting language must "watch" many different event sequences or "strings" simultaneously. In a most complex case the scripting system would have to watch every single variable of thousands of variables in a complex industrial simulation as well as all communications channels and any other sequences of events that may be generated through the user interface by the user. Each one of these "strings" would have certain conditions set for it. If the pre-established condition for any "string" was met, then the scripting system would act for that particular string of events, no matter what was happening to the rest of the system.

Types of simulation-based evaluation tools

Praxis Technical Group, Inc. has developed several simulation based evaluation tools. Generally these have been built around simulations of computer controlled industrial processes. Simulations of air traffic control problems have also been developed. These evaluation tools are currently being used to select candidates for industrial computer control system operators and air traffic controller positions. In both cases classes of selected candidates have shown dramatically increased ability to learn required skills and dramatically lower levels of stress during the training period than have classes of candidates who were not selected by simulation based tools.

The payout for both trainees and the training organizations has been considerable. Trainees are being selected for jobs for which they have a natural aptitude. As a consequence, stress levels during training and on the job are greatly reduced. It has been shown that only about 20 percent of the working population have a strong natural ability to perform these control related tasks. Operator stress and general safety are markedly improved if operators are naturally suited to the jobs they perform.

The payout for corporations and training organizations has also been considerable. In the case of air traffic control candidates it is not uncommon to spend approximately one million dollars per candidate to reach the stage at which the candidates ability can be assessed. It is not uncommon for approximately half of the trainees to be "washed out" at this stage. For each class, therefore, several million dollars are wasted. Indications are that costs in the process industries are proportional. The use of simulation based aptitude evaluation tools can cut these costs dramatically. Further

benefits result from the higher competence of selected candidates once they become full operators. These benefits show up in improved operation and improved safety.

Praxis Technical Group, Inc. has also begun to experiment with specialized simulators that simulate the process of negotiation. We are looking for specific skills and aptitudes that differentiate successful negotiators from unsuccessful negotiators. This work is still in an experimental stage. Similarly, Praxis has begun work with various types of business simulations. The simulations simulate various types of business environments. We will be looking for entrepreneurial skills and abilities.

Java and the simulation of collaborative environments

Praxis has recently developed a 100 percent Java-based simulation environment which can perform all the tasks of the environment described here with the additional abilities of being able to run several interacting simulators simultaneously across a network or the World-wide Web and the ability to combine the collaborative efforts of widely distributed trainees. It will be interesting to see if this Java system can be used to develop simulation based aptitude evaluation tools which can distinguish certain social skills necessary for effective team players.

Greg Milbank is Managing Director of Praxis Technical Group, Inc.

FEEDBACK POSSIBILITIES IN A LESSON-PLANNING SIMULATION

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Early in their professional training, preservice teachers at the Curry School are introduced to several fundamental aspects of lesson planning via a Windows-based instructional aid called the Teaching Decisions (TD) simulation (Strang, 1996). Each participant, assuming the role of a teacher, engages in a series of decision-making activities in planning a 30-minute lesson for a small class of pupils. The planning task comprises four activities, each defined by a separate work window. These activities include (1) becoming familiar with individual pupils by studying and taking notes on their academic ratings and their personality traits, (2) deciding where pupils will be physically stationed and with whom and what (computers, blackboards) they will work, (3) developing the lesson activities that individual pupils and/or groups of pupils will complete, and (4) determining what the teacher will do during the lesson. Later in the semester when all students have completed the interactive phase, 8-12 students gather for group debriefings. At this time each participant receives a printed report that presents personal information about that teacherís lesson-planning activities. During these 30-minute sessions, the students, with the aid of a series of computer-generated screen displays, compare their personal records with computer-generated composites derived from their class cohort and from experienced-teacher cohorts. These personal-group comparisons are designed to stimulate realistic student discussion on effective lesson planning.

Types of student feedback

Students may receive any combination of five types of lesson-planning feedback after they complete the TD simulationís interactive phase. The first three software-generated feedback printouts offer personalized information concerning the teacherís (a) step-by-step movement through the task, (b) recognition of individual pupil differences, and (c) planning focus, respectively. The fourth report offers a composite of both navigational and planning measures. The fifth instrument presents a graphical printout of factors that define the more global aspects of the teacherís lesson-planning style.

Feedback on step-by-step navigation

The Navigation Event Record provides an event-by-event description (including a time line) of all mouse and keyboard entries which the teacher has made during the simulationís interactive phases. During debriefing, this report is particularly useful in helping students to focus on the individual decisions and time commitments that they made as they planned each lesson component.

Feedback on the recognition of individual pupil differences

The Pupil Planning Profile provides numerical data on 10 major planning decisions that teachers rendered for individual pupils. Variables defining the teacherís evaluation of individual pupil academic and personality characteristics prior to initiating planning actions include (a) the amount of time spent studying a pupilís records and (b) the number of notes taken during this process. Additional variables tap pupil spatial and activity assignments as well as the proportion of time the teacher planned to spend with each pupil.

Feedback on planning focus

The Planning Outcomes Profile displays general decision patterns that the teacher exhibited while completing the simulationís interactive phase. A review of this recordís numerical data reveals whether, in taking notes on pupils, the teacher focused on positive or negative traits or favored academic information over personality traits. Numerical comparisons also reveal preferences for blackboard or computer assignments, for personalized or standard lesson activities, and for working with individual pupils, groups of pupils, or the entire class.

Feedback on composite measures of navigation and planning

The Simulation Summary Profile offers a sampler of information concerning six navigation and planning activities. These activities include moving across work windows, selecting feedback windows, developing note lists for pupils, making pupil spatial assignments, deciding upon lesson activities, and allocating teacher time to pupil groups.

Feedback on decision-making style

The Planning Strategies Profile is the most recently developed feedback instrument. This graphical record allows participants to view their planning decisions within a broad contextóa context defined by a global lesson-planning style. Work has begun on defining the major dimensions that define these styles.

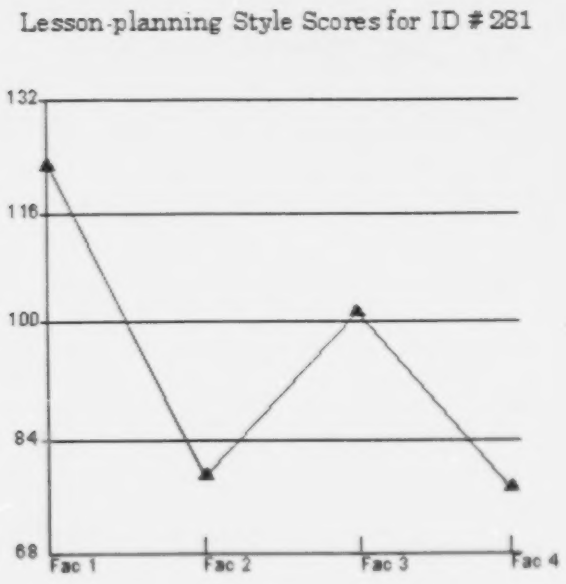

Figure 1. The Planning Strategies Profile

Factor analysis of the 1996 preservice cohort has yielded a clear factor structure. This structure addresses distinct decision-making factors that define four major TD simulation lesson-planning dimensions. Note that the vertical axis in Figure 1 depicts scores, and the horizontal axis depicts the four factors as described below. The cohort mean is 100; the standard deviation is 16.

1. **Organizing the planning tasks.** High scores on this factor indicate that the teacher was flexible in navigating the four tasks that collectively define the lesson-planning assignment; low scores indicate that the teacher exhibited a more conventional linear navigating style. The planning variables that define this factor consist of measures of how frequently the teacher (a) moved from one task to another, (b) revisited work windows that had already been accessed, and (c) initiated unconventional forward jumps across tasks.
2. **Using information.** During lesson planning, the teacher had immediate access to seven types of information via a single mouse click. This information, presented in a feedback window adjacent to the work window, included instructions for navigating the current work window, notes describing pupil characteristics, planning decisions recorded on work windows that were not currently visible, the lapse time spent in planning, and enlarged graphical representations of pupil faces. High scores on this factor indicate that the teacherís approach to using information in lesson planning was defined by scanning a variety of feedback sources; low scores indicate that the teacherís approach was defined by focusing on a specific source of information. Variables constituting this factor include the frequency of information-window changes and the number of different types of information that were accessed during the planning.
3. **Relating to pupils.** High scores on this factor indicate that in planning the lesson the teacher relied heavily on the needs of individual pupils; low scores indicate that the teacher did not. Variables that define this factor include the frequency of assigning pupils to work alone, the amount of teacher time allocated to individual pupils, the variety of equipment used for instruction, and the number of different activities assigned during the lesson.
4. **Developing lesson activities.** High scores on this factor indicate that the teacher exhibited a high degree of indecision in assigning lesson activities; low scores indicate that the teacher did not. Variables constituting this factor include the amount of time the teacher spent in assigning lesson content and the frequency with which the teacher reviewed program-defined content descriptions, authored personalized lesson activities, and reworked previously developed content assignments.

Student debriefing

A typical group debriefing session

The group debriefing sessions that follow the interactive lesson-planning task enable each participant to study personal lesson-planning records, to compare their personal performance on these instruments with that of peers and experienced teachers, and to use this feedback as a base for engaging in a discussion with their peers concerning effective lesson planning. Each 30-minute session begins with the distribution of one or two feedback reports. After having an opportunity to study their personal records, the 8-10 students attending each debriefing session can compare their personal performance with that of their peers and a cohort of experienced teachers. A Visual Basic tool allows the debriefer to read all cohort or other group data

files and create a series of screen images (projected via an LCD panel) that display histograms and/or pie charts depicting the average group scores for variables listed on the current feedback instrument. Figure 2 presents information provided to the 95 preservice teachers comprising the fall 1996 cohort. This graphic includes both peer and experienced teacher comparative measures for that category of the Simulation Summary Profile that addresses teacher time commitments. The left bars depict averages for a cohort of 31 experienced teachers; the right bars depict averages for the cohort of 95 peers.

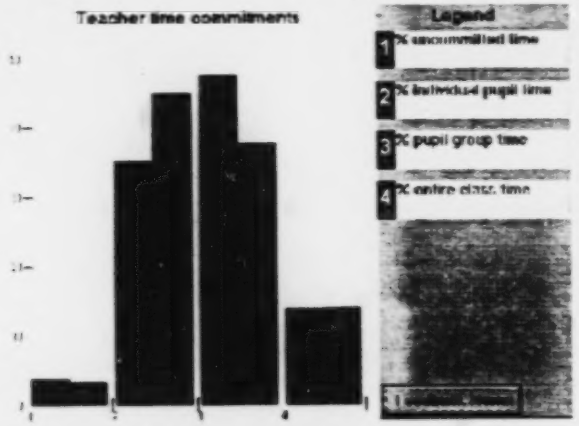

Figure 2. The group display for teacher time commitments

Student evaluations of debriefing

Both ratings and comments gleaned from a questionnaire administered at the conclusion of the 1996 debriefing sessions affirm the instructional value of the debriefing feedback but also indicate that there is room for future improvement. Rating results reveal that 78.2% of respondents clearly felt that the debriefing experience was helpful. Rating differences, however, emerged across the sexes. The 65 women who completed the questionnaire exhibited a higher positive collective rating score for the three items that focused on helpfulness of the debriefing than did the 13 men who completed this instrument [$t(76) = -2.04 p < .05$]. Inspection of the ratings of peer and experienced teacher feedback reveal another important finding. While 51% of women and 69% of men indicated no preference for peer versus experienced teacher feedback, a substantial block of women (43%) and men (31%) rated the experienced-teacher feedback more helpful than the peer feedback. Only four women in the entire sample rated the peer feedback more helpful than the experienced-teacher feedback.

Student comments included on the questionnaires generally support the instructive value of the debriefing experience. Positive comments focused on (a) having the opportunity to practice lesson planning, (b) becoming more aware of the complexity and the time demands of the task, and (c) learning to balance class instruction with one-on-one instruction. The theme expressed by the minority of students who wrote negative comments centered on being confused by the amount of information presented in such a short period of time and being uncertain of what they had learned.

Future applications

Based on the questionnaire findings and on unsolicited information obtained through informal dialogue exchanges with students throughout the year, the Curry simulation team is currently considering implementing several changes to enhance the feedback value of the debriefing sessions. These changes include (a) devoting more time to the debriefing, (b) focusing on fewer and more clearly defined feedback measures during the debriefing, and (c) linking the entire debriefing experience more closely to the academic coursework that the preservice teachers complete during their simulation experience. Coupled with this movement toward better integration will be an increased effort to enhance the instructional efficacy of the simulation by involving the faculty teaching the parallel courses more completely in all aspects of project development.

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DOES LESSON-PLANNING SIMULATION PERFORMANCE PREDICT CLASSROOM A D FIELD PERFORMANCE?

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Over the past three years, almost 300 students at the Curry School have completed the Visual Basic Teaching Decisions (TD) simulation during the early phase of their teacher-training program. As described by Strang (1998), the feedback provided by this interactive experience allows participants to compare personal lesson-planning decisions with those of their classmates and with those of experienced teachers. The evolving softwareís lesson-planning measures have increasingly become more sophisticated and sensitive to individual participant differences. For example, Sullivan, Yeh, and Strang (1997) found that lesson-planning strategies of experienced teachers differed from those of their inexperienced peers. The present exploratory study focuses on a cohort of students enrolled in the Curry Schoolís teacher-education program. The first research goal is to identify the major types of lesson-planning strategies that these teachers-in-training employ as they complete the TD simulation. The second goal is to determine whether the identified planning types relate to other simulation performance and rating measures, to demographic variables including age and sex, and most importantly, to performance in other areas of teacher preparation. These areas include (1) academic achievement in teacher-preparation courses and (2) future teaching performance in field settings. The underlying purpose of this research is to explore whether the TD simulation has diagnostic value. Most importantly, to what degree can TD performance scores be used by teacher educators to personalize preservice teachersí future academic and field experiences so as to maximize their effectiveness when they work with ìliveî students in the field?

Identifying types of lesson-planning strategies

Through the use of factor analysis, Strang (1998) has isolated four decision-making dimensions that define preservice teachersí performance on the TD simulation. The factors address how participants (1) organize their movement through the task, (2) use information during planning, (3) focus on the needs of individual pupils, and (4) demonstrate decisiveness in developing lesson activities. In the current study, an attempt was made to determine how these dimensions interact to produce patterns or types of lesson-planning strategies. An iterative partitioning method of cluster analysis (Aldenderfer & Blashfield, 1984) was employed to determine the clustering patterns of a sample of 95 preservice teachers who had completed the simulation during the fall of 1996. Maximum distance and iteration frequency played a strong role in determining that the following 5 clusters would be retained for further analysis.

Type 1. This cluster included 4 students who exhibited high flexibility in moving through the planning task but displayed relatively little concern with meeting the needs of individual pupils.

Type 2. This cluster included 32 students who exhibited low flexibility in moving through the planning task, focused on specific information rather than on scanning during decision making, displayed little concern with meeting the needs of individual pupils, and exhibited little indecision in assigning lesson activities.

Type 3. This cluster included 21 students who focused more on scanning information sources than on using specific information for planning, and exhibited little indecision in assigning lesson activities.

Type 4. This cluster included 4 students who exhibited high flexibility in moving through the planning task, focused on specific information rather than on scanning during decision making, displayed great concern with meeting the needs of individual pupils, and exhibited little indecision in assigning lesson activities.

Type 5. This cluster included 34 students who exhibited only one traitóa high degree of indecisiveness during the assignment of lesson activities.

Expanding our understanding of planning types

The next step in the research plan involved increasing our understanding of the 5 planning types by assessing their relatedness (a) to other measures obtained from simulation planning performance and post-participation ratings, (b) to key demographic variables, (c) to academic achievement in a learning and development course, and (d) to supervisor ratings of teaching performance in a field setting. Since this is an initial exploratory study and two of the planning types included only four students, relationships among the types and specific variables were established by simple observations of variable means and standard deviations rather than by more rigorous group statistical analyses.

Relationships with simulation performance and rating variables

Several relationships were gleaned from a review of simulation performance measures that had not been used to define the planning typesí component factors and from a questionnaire administered immediately following the teachersí completion of the simulation debriefing session. The eight-item questionnaire addressed participantsí motivation during the simulationís interactive phase and their perceptions of its user-friendliness and value as an instructional vehicle.

Type 1 participants generally took a long time to complete the task yet spent little time reading either initial instructions or instructions describing how to complete specific planning tasks. In preparing to interact with pupils, these teachers spent relatively little of their planning time studying the characteristics of their future pupils. They did, however, anticipate devoting much time during the lesson to interacting with pupils. Their planning responses suggest that these interactions centered on providing pupils with information. Type 1 participants tended to positively identify with that part of the debriefing which enabled them to compare their personal planning results with those of a group of experienced teachers. Finally, they tended to rate their motivation during the lesson-planning experience as high.

Type 2 participants engaged in the simulation-planning task for a relatively short period of time.

Type 3 participants exhibited one distinct behavior during planningóthey were likely to try to exit the planning task prematurely.

Type 4 participants studied the initial simulation instructions for a relatively long period of time; they also tended to engage in the simulation-planning task for a lengthy period. They spent a relatively large proportion of this planning period in studying the characteristics of their future pupils, and they anticipated devoting a large amount of their time to interacting with pupils. Finally, they tended to rate the feedback that they received during debriefing as helpful.

Relationships with demographic variables

The following relationships were observed when demographic variables including age, sex, 4 SAT performance measures, prior experience working with children, and teaching area variables were compared across the 5 clusters.

Type 1 students generally achieved high SAT scores on vocabulary and reading. Students in this cluster, however, reported relatively little experience working with children in diversified settings.

The Type 2 cluster contained a disproportionately large number of physical education majors. Also, 3 of the 4 students who dropped out of the teacher education program were members of this cluster.

The Type 3 cluster contained a disproportionately large number of men.

The Type 4 cluster was comprised of 4 female elementary education majors whose verbal SAT scores were generally high.

Relationships with academic performance variables

The following relationships were observed when academic achievement in a learning and development course that all Curry teacher-education students complete early in their programs was compared across the 5 clusters.

Type 4 students tended to exhibit strong improvement from their midterm to their final examinations and generally earned high course grades.

Relationships with field experience rating variables

Supervising teachers used the following rating categories to evaluate the preservice teachersí performance in the field.

1. *Professional responsibilities* includes managing assignments, scheduling daily routines, and meeting attendance responsibilities.
2. *Professional commitment* includes seeking knowledge about the discipline of pedagogy, exhibiting appropriate practices in the classroom and school, and volunteering for assignments.
3. *Professional relationships* includes working cooperatively with mentor-teachers and other professionals, seeking feedback on assignments, and maintaining professional confidences.
4. *Professional skills* includes developing appropriate classroom skills, responding to instructional and emotional student needs, and displaying overall effectiveness during the field experience.

Inspection of supervisor ratings yielded the following 2 relationships.

Type 1 students were rated relatively low by their field observers on professional responsibility, professional commitment and professional skills.

Type 4 students were rated relatively high by their field observers on professional responsibility, professional commitment and professional relationships.

Type summaries and conclusions

The results obtained from this exploratory study provide interesting portraits of several types of lesson plannersótypes that appear to be anchored either to affective or cognitive foundations. The principal characteristic of Type 1 planners appears to be egocentrism. These teachers, reporting that they had had little experience working with children, were largely concerned with completing the lesson-planning task on their own terms and in ìfilling upî lesson time with what they deemed to be important academic information. Moving to the academic and field arenas, members of this cluster had extensive vocabularies and were strong readers. Their relatively low field evaluations may reflect the difficulty that these preservice teachers experienced when their self-centeredness hampered their ability to profit from the feedback provided by their field supervisors.

The principal characteristic of Type 2 planners appears to be the cognitive attribute of low commitment. These preservice teachers completed the lesson-planning simulation relatively quickly by following the preset linear decision-making template, by seeking out few information sources, by employing few options to individualize pupil instruction, and by exhibiting low indecision in assigning lesson activities. Interestingly, 3 of the 4 students in the preservice cohort that withdrew from the teacher education program were Type-2 planners.

The principal characteristic of Type 3 planners appears to be the emotional attribute of low motivation. In the planning simulation, these participants tended to ìsurfî indiscriminately through both valuable and relatively useless (e.g., enlarged pictures of student faces) information sources, exerted little effort toward developing lesson content, and were likely to attempt to exit the planning task prematurely. It is interesting to note that this cluster, which is in part defined by information surfing, is also over represented by men.

The principal characteristic of Type 4 planners appears to be competence. These preservice teachers studied instructions carefully and devoted a relatively long time developing their lesson plans. They studied the characteristics of their future pupils very carefully before they began making actual planning decisions. During planning, they were flexible in moving across decision-making categories. They also tapped relevant sources of information in their decision making, focused on meeting the needs of individual pupils, displayed little indecision in assigning lesson activities, and anticipated spending a relatively large portion of lesson time interacting with pupils. Moving to academic and field settings, the four women constituting this cluster had high verbal SAT scores, demonstrated improvement across tests and earned high grades in the learning and development course, and received high field participation ratings from their supervising teachers.

With only one simulation performance factor defining it, Type 5 provides the least clear picture of a lesson-planning style. The principal characteristic of Type 5 planners appears to be indecision in responding to one of the planning taskís chief challenges—developing lesson activities for pupils. Illustrating this struggle, Type 5 planners spent a relatively higher proportion of their time engaged in making activity choices, frequently checked activity definitions, and repeatedly changed activity assignments.

Two major conclusions can be drawn from the results of this pilot study. First, effort needs to be directed toward making the simulated lesson-planning task more meaningful to a larger number of participants. Strang (1998) discussed the importance of post-planning feedback and debriefing and suggested several ways in which this phase of the task can be improved. Additional efforts must also address the breadth of the simulationís planning options with particular attention paid to the availability of realistic lesson activities.

The second conclusion drawn from the current study is that lesson-planning performance exhibited during the simulation not only provides helpful personal feedback to student participants, but it can also be used as a tool by professors and field supervisors to guide these students as they move from classroom theory to real-world teaching. For example, type information gleaned from simulation performance measures might (a) alert teacher educators as to the special needs of their ìegocentricî preservice teachers, and (b) sensitize teacher educators to motivational issues in ìlow-commitmentî preservice teachers.

In closing, it must be emphasized that the current study needs to be replicated to confirm the factor structure, cluster results, and variable relationships suggested in this paper. The replication cohort will include over sixty students currently completing their first year in Curry Teacher Education Program.

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Capturing the Process of Thinking with Online Computer Simulations

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Constructivist educators emphasize the process of thinking and learning. Bednar, Cunningham, Duffy and Perry (1992) state, "Constructivists focus on the process of knowledge construction and the development of reflexive awareness of that process" (p. 24). Jonassen (1996) writes that computers must serve as knowledge construction tools that "support, guide, and extend the thinking processes of their users" (p. 10). Further, constructivists stress the understanding o a particular student's thinking process over the observation of his or her correct answers (Confrey, 1991).

However, authors such as von Glasersfeld (1991, 1995) note that understanding an individual's thinking process is a rather elusive endeavor. He writes that "models we construct of other people's ideas and mental operating... are necessarily hypothetical because we have no direct access to what goes on inside other people's heads" (von Glasersfeld, 1991, p. xvi). Nevertheless, teachers must strive to make sense of and value the thinking of their students by constructing hypothetical models of each student's thought process (von Glasersfeld & Steffe, 1991; von Glasersfeld, 1995). This construction best occurs through linguistic communication with the student (von Glasersfeld & Steffe, 1991).

The ensuing paper, although not documenting a challenge to this claimed superiority of linguistic communication, presents an additional or perhaps complimentary approach to the exploration of student thinking. This approach is supported by a Web-based tool that qualitatively captures the process of thinking. After introducing the background for tool design, the paper will briefly describe the tool and illustrate its use in mathematics education. The paper will conclude by discussing the tool's strengths and weaknesses.

Background for Tool Design

By analyzing post-test results, substantial valuable research has addressed the learning effects of computer simulations (e.g. Brant, Hooper & Sugrue, 1991; Thompson & Wang, 1988). However, while this research often examines cognitive outcomes after simulation use, another smaller and important strand of simulation research examines cognitive processes during simulation use. This research examines what is often missed — the process of student thinking and problem solving. For example, by using computer simulations which automatically deposit student interactions (protocols) on a local disk, several investigators have explored patterns of student thinking by searching the stored data files (e.g. Hooper & Thomas, 1990; Upah & Thomas, 1993). Although examination of protocols can be time-consuming and tedious, these investigators found this task to be a valuable source in speculating about thinking processes which may not otherwise be observed.

Turoff and Hiltz (1995) further advance the ideas of simulation design. They believe a powerful addition to simulation use is the capability to 'record and playback' simulation input in virtual environments. Here, instructors could record their input to a simulation, and students could replay this input to "see how the problem solving process of the instructor unfolds as he or she goes through the process of dealing with some complex problem in [an] application domain" (p. 207).

When considering the ideas of Turoff and Hiltz and the investigation of student protocols, immediate research implications may hold for computer-mediated communication activities in teacher education. For example, Poole (1996) created an environment which connected preservice teachers with elementary students across the United States. Preservice teachers sent mathematical problems to their assigned students each week via e-mail, and the students responded with a solution and an explanation of their solution process. However, when the students did not clearly articulate their solution process, the preservice teachers "could only reply to the correctness of a response rather than [provide] more detailed feedback that might help the elementary students develop better problem solving skills" (p. 159). Although one of Poole's primary goals was to foster the preservice teachers' selection of appropriate mathematical problems, future networked situations may be viewed in light of protocol research and

Turoff and Hiltz's suggested design: These situations may be supported by representing a general problem in an online computer simulation and providing the capability to record, playback, and guide the process of student thinking and problem solving.

Tool Description

The background presented above, namely the value attributed to protocol analysis and the potential power of 'record and playback' functionality, motivated the design framework for a new computer-mediated tool. Furthermore, the impetus for creating this tool was spurred by the belief that preservice teachers could constructively use this tool to explore the cognitive and metacognitive problem solving processes utilized by elementary or secondary students — independently of time and space.

Thus, a tool manifesting the theoretical 'record and playback' functionality suggested by Turoff and Hiltz (1995) was created. Although not specifically duplicating their proposed design, this particular tool's functionality permits the storage and playback of user interactions with computer simulations. Additionally, because the tool is Web-based, the need for localized storage of simulation protocols is negated and the boundaries of protocol research are extended.

This tool is implemented as an assignment type built into a larger virtual classroom management system known as ClassNet (Van Gorp & Boysen, 1997). ClassNet is designed to support a growing hierarchy of Web-based assignment types such as tests, surveys, and instructor evaluations. One assignment type, termed cnet-java, allows retrieval of Java simulations from ClassNet and storage of interactions with those simulations inside ClassNet's database. Researchers and teachers can later analyze or playback these protocols.

Sample Protocol Session

The following sample session illustrates the playback of student protocols. The protocol figures, extracted over a period of 2 days, are taken from a recent research study which evaluated the use of protocol analysis in preservice teacher education. To reduce the number of figures needed, repeated "Step"s are combined; however, when using the actual simulation, a line is drawn or a conjecture is presented each time the teacher presses "Step". This gives a feel for the thought process of the student.

Session Context

Three preservice teachers were connected online with 2 pairs of eighth-grade boys enrolled in a pre-algebra course. The eighth-grade pairs had only previously graphed lines by creating and plotting tables of (x, y) points. Subsequently, the preservice teachers and the eighth graders cooperatively worked with a cnet-java assignment that extends the plotting of table points to the exploration of linear equations.

The graphing simulation embedded in this assignment, known as "Lesson Graph" (see Figure 1), allows students to experiment with linear equations of the form $Ax + By = C$. It is designed to support student exploration and conjecturing about the relationship between the parameters of algebraic equations and characteristics of their graphical representations. To use the simulation, students enter numbers for the coefficients and instruct the simulation to plot the line. By selectively changing the coefficients and observing the results, students can gain and articulate an understanding of concepts such as y-intercept and slope. Further, students enter posed conjectures into a conjecture box by clicking on "Post Idea". These conjectures and entered numeric coefficients leading to the conjectures are automatically routed to and stored in ClassNet. Students may also press "Reply to Teacher Notes" to read and respond to guidance entered by their assigned teachers.

Meanwhile, to take advantage of replay capabilities, Lesson Graph presents a slightly different interface to teachers (e.g. see Figure 2). By clicking on "Get Data", protocols may be retrieved for a particular student. Teachers then repeatedly click "Step" to sequentially replay the student's entered coefficients, graphed lines, and posed conjectures. After thinking about and discussing the student thinking, the teachers enter guidance by pressing "Send Notes to Student". The students use this guidance for support in subsequent sessions.

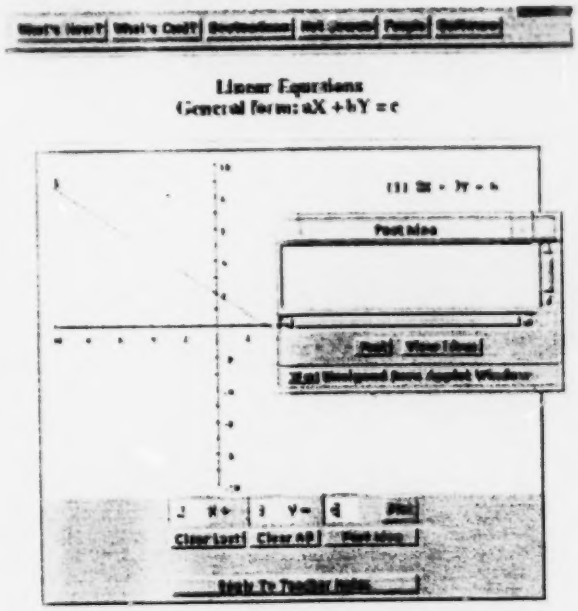

Figure 1. Lesson Graph's Student Interface.

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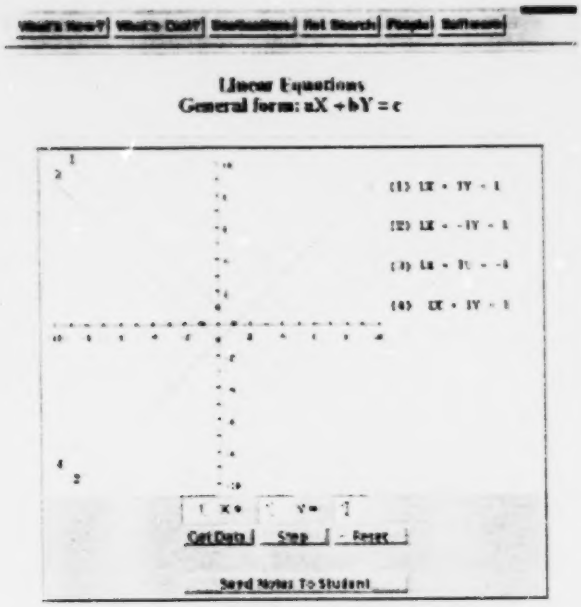

Figure 2. Lesson Graph's Teacher Interface Revealing an Initial Discovery of Perpendicular Lines.

For approximately 1 week, each student pair interacted with Lesson Graph every afternoon. Meanwhile, the preservice teachers accessed Lesson Graph every evening, replayed and discussed the student protocols, and sent appropriate guidance for future simulation use. The purpose of this guidance was to constructively support students in their discovery of linear concepts and promote the use of metacognitive strategies.

Session Illustration: Creating Perpendicular Lines

The student pair highlighted in this illustration had already utilized an important metacognitive strategy to discover parallel lines: They held two variables constant (A and B) while changing the other (C). The preservice teachers emphasized the importance of this strategy and sent guidance that challenged the students to create perpendicular lines.

In response to the teacher's challenge, the students began exploring perpendicularity and eventually discovered how to create perpendicular lines by changing a sign on the A or B coefficient (see Figure 2). They then replied to the preservice teachers' original challenge (The preservice teachers' challenge is shown first.):

Teacher > Do you know the opposite of parallel? If so try experimenting with that.
Student > Yeah! We did it.
Student > Look through our equations. 1x+1y=1, 1x+-1y=1

Unfortunately, the students had failed to test their hypothesis with numbers other than -1 or 1. Later, in the same protocol session, the students also created perpendicular lines with 0's and 1's (see Figure 3), but they did not relate this discovery to the previous discovery of A or B sign transformation.

After playing back the protocol and thinking about the students' discovery, the preservice teachers sent the following guidance that evening:

Teacher > You found perpendicular very well.
Teacher > Can you find it using 1x + 2y = 3?

This was a valuable task for the teachers as they attempted to invoke cognitive conflict through the use of a counter-example: Changing signs of the A or B coefficients in this equation will not produce perpendicular lines.

On the next day, the students applied their newly found conjecture to the equation sent by the teachers. However, they now discovered that changing the signs of the A and B coefficients did not produce perpendicular lines (see Figure 4). To remedy this misconception, the students eventually brought previously constructed knowledge to the forefront (see Figure 5): They had used 0's and 1's to create perpendicular lines the previous day. The student pair now realized that changing the A and B coefficients also creates perpendicular lines and combined this knowledge with their previous hypothesis of changing the signs. At last, a line perpendicular to 1x + 2y = 3 was constructed (see Figure 6).

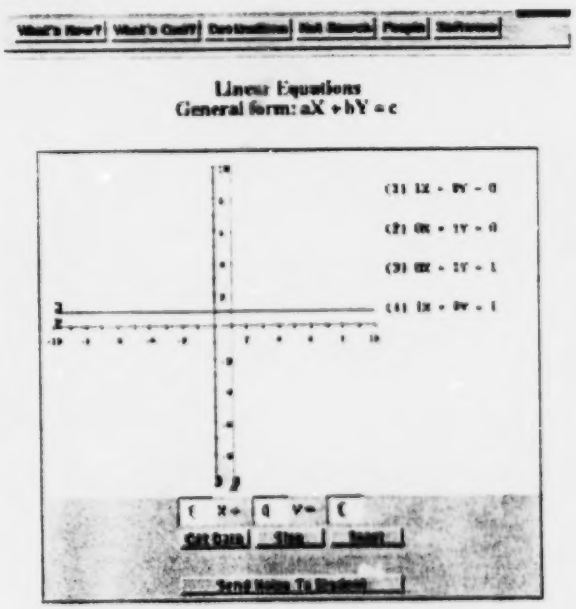

Figure 3. Perpendicular Lines with 0's and 1's.

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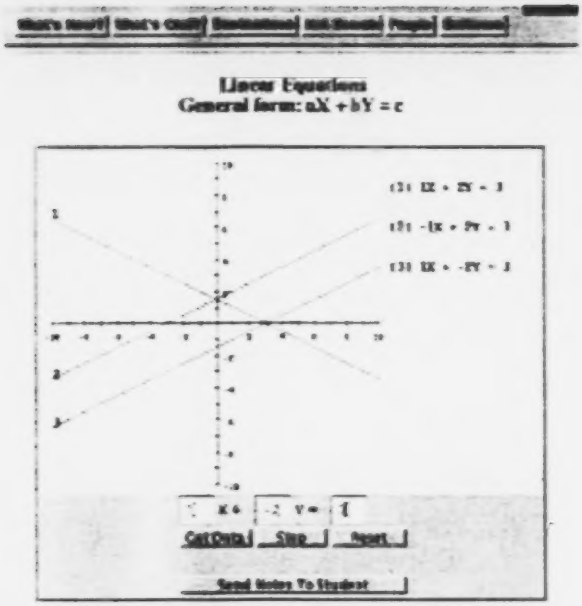

Figure 4. Experiencing Cognitive Conflict.

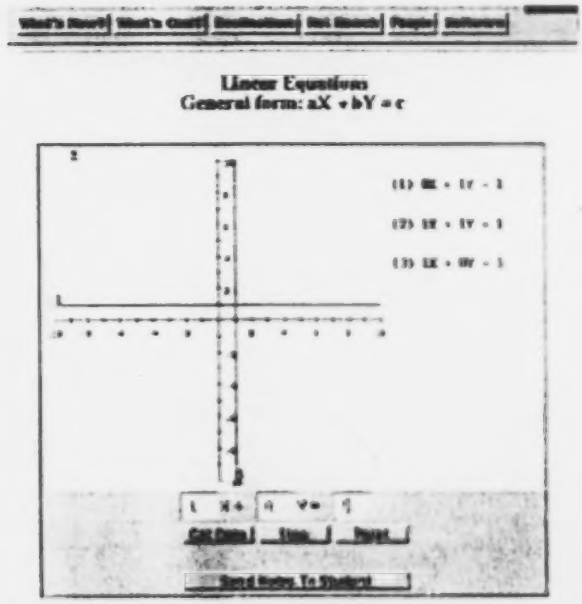

Figure 5. Thinking Back to a Previous Discovery.

Discussion

Capturing and playing back remote student interactions with Java simulations provides an interesting arena of research. Its primary strength is that preservice teachers or researchers can easily analyze and discuss cognitive and metacognitive processes employed by the student users of a simulation. This is particularly important for preservice teacher education as impending issues of classroom discipline and organization may hinder preservice teachers from ever thinking about student thinking. Further, the asynchronous nature of protocol research gave the preservice teachers time to collaboratively construct optimal guidance to send.

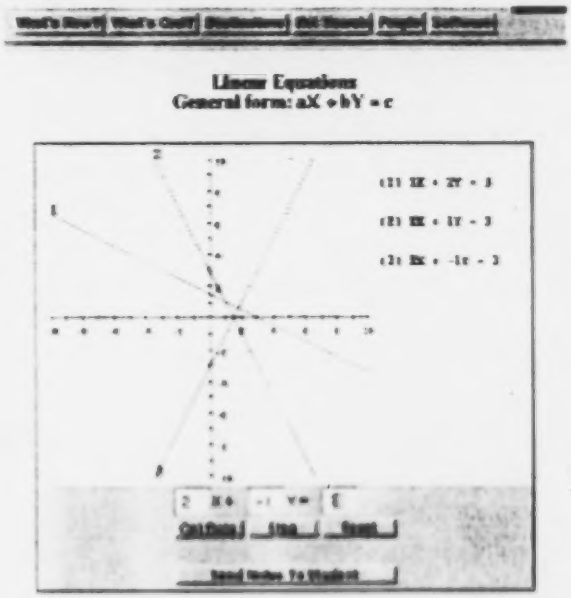

Figure 6. Final Discovery of Perpendicular Lines.

Nevertheless, protocol capture and analysis in this study did have various weaknesses. These weaknesses were primarily due to the asynchronous nature of the study. For example, the preservice teachers could only hypothesize about the student thinking based upon the stored data (i.e., the graphed lines, conjectures, and replies to teacher notes) and could not immediately ask the students about their thoughts. Further, the students could have periodically benefited from immediate guidance that directed and enriched their exploration. Another drawback was the lack of non-verbal cues: The only means of determining levels of confusion or enjoyment was to ask the students through written notes. Finally, creating an actual simulation and connecting it with ClassNet was not a trivial task. It involved computer programming expertise.

These weaknesses lead directly into future research. For example, synchronous guidance may be included by either programming this capability in or by making use of commercial tools. Many commercial tools also support the synchronous transmission of audio and video. Thus, one

may conceivably observe remote students working with a simulation, communicate with them by audio or type-written chat, and view the student interactions with that simulation - all at the same time. Although asynchronous communication gives novice teachers the time they need to construct guidance, more advanced teachers may benefit from this synchronous challenge. Finally, future research might also address the creation of tools that simplify the storage and analysis of protocol data.

Conclusion

The strengths and future research ideas for the capture and analysis of simulation protocols suggest that similar activities should continue to be investigated. These activities may potentially benefit not only the user of the simulation but also the analyzer of the user's interactions. Simulation utilization coupled with the advent of Java and World Wide Web technologies is one means of permitting new teaching, learning, and research opportunities that were previously not possible. Similar web-based experiences must continue to be envisioned and explored.

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SOCIAL STUDIES

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Social studies education has long suffered a malaise regarding its efficacy among teachers and students. What with debates centering around its very definition and goals, very traditional approaches to curriculum and instruction, and students stating that social studies is boring and irrelevant, there is no wonder that the discipline and its advocates suffer from a confidence problem. The articles included in the social studies section each address these issues in their own way. The overriding theme of the papers as a whole can be described as suggesting that social studies education be transformed through technology and constructivist integration, and that teacher education is an ideal arena for the transformation to begin. Many state that the ultimate goal of social studies is to assist in the development of active citizens who are able to think critica and solve problems. If this truly is the goal rather than the perpetuation of the status quo and the continued facilitation of hegemony, then transformation is not only needed, it is required. The papers included herein offer ideas for such reform.

Jones and Bennett describe the establishment of *The Jamestown Virtual Colony*, a web-based online resource for teachers that includes plans, documents, outlines, bibliographies, and web links. The project is thematically organized and is designed to be interactive and possess ongoing development. The goal is to offer an improved strategy for integrating technology in social studies education for preservice and inservice teachers and their students. The authors utilize the web because of its tremendous potential in facilitating data gathering skills development. A model for social studies teacher education is also provided in the paper. True technology integration in preservice programs suggest email, personal web page, and Internet resource applications focusing on lesson and unit design and implementation. The paper concludes by including limitations and really suggestions for more collaborative web-based projects for social studies education. Projects such as this can only assist in the transformation of social studies education toward a more relevant, student-centered learning experience.

Dowling describes a collaborative project entitled *The Community Discovered*. The goals of the project includes the linking of art and technology through a constructivist framework and designed for disadvantaged students. The ultimate outcome of the project is the development of curriculum activities based on electronic museum materials. A variety of participants and projects have been employed in initial development. Also included is a review of literature regarding successful integration of technology and project-based learning in schools. Innovation diffusion literature is also thoroughly reviewed. The paper also includes a preliminary review regarding success of the project and suggests that constructivism is an appropriate strategy. A school wide technology focus is also suggested for successful implementation. The authors are quite upfront with early evaluations and provide very relevant ideas for project implementation that has generalizability for similar endeavors. The paper concludes with recommendations to facilitate broad-based implementation of the project. The thorough literature reviews that respectively integrate technology integration and innovation diffusion tied to the early evaluation of this project offer powerful ideas for future technology projects in social studies education.

Cole Slaughter and Jones suggest in their paper that the World Wide Web is an innovative tool for research and telecommunications for teachers and students in learning about different cultures. The paper describes the implementation of a culture box (or an electronic version called cyber cube) for inquiry activities regarding different cultures. Examples of culture box applications are included in the paper. The authors suggest that by including technology via the world wide web the culture box transforms into a cyber cube. Preservice teacher comments and reflections are included to give credence to the project. The culture box/cyber cube example provided is on Australia with several relevant web sites listed. The authors conclude by stating that culture box/cyber cube activities provide multisensory, multi-modal learning that enables the transfer of knowledge through a motivation inquiry and technology-based

project. Such an activity provides an innovative method for integrating technology in developing a community of learners and in developing a more meaningful global perspective.

Ledford and Peel state in their paper that the preparation of teachers requires the modeling of technology as a tool to provide relevant connection to the world for students. They suggest that the Internet offers access to current information and historical documents which enables active learning in the classroom. A number of web sites are listed that correlate directly with the ten thematic strands suggested by the National Council for the Social Studies. The listings include practical information such as the title of the web site, web address, and description of the site. The goal as indicated in the paper is to integrate technology in such a way as to allow preservice teachers the opportunity to apply Internet resources in developing curriculum and instruction.

Adamy and Madden describes a project that enhances social studies instruction by using the web to improve student awareness of social, historical, and ethical issues surrounding WWII. The authors discuss the importance of developing foundational knowledge and a sense of empathy for true historical understanding to occur. Prescriptive and constructive web sites are described with the paper suggesting that interactive sites possess the highest potential for learning. The project includes the development of a web site designed focusing on students' interests with the Underground Railroad serving as the connection to WWII. The intent is that students should be allowed to interact in constructing knowledge and that technology can assist in this learning with students creating their own stories while placing themselves in the scenarios presented.

The papers in this section of the annual indicate that there is hope for transformation in the integration of technology in social studies education both at the K-12 and teacher education levels. We can now only suggest that continued efforts are made to nudge the disciplines of social studies education, information technology, and teacher education is ever more empowering directions for teachers and students.

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Teaching in the Information Age: The Jamestown Virtual Colony

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Teachers genuinely hunger for resources to help them in teaching content. One need look no further than the eager cajoling of textbook representatives in conference exhibition halls, the frantic searches through book storage rooms when last-minute course assignments are announced in August, or the multiple visitors to ERIC gopher sites. If a workshop presenter offers good ideas, he or she will find every copy of the handouts snatched up. Starting teachers might be in search of *any* help as they confront content for the first time; seasoned teachers might be no less eager in the pursuit of fresh ideas. Good teachers are likely accustomed to requests from colleagues to share copies of their creations.

Programs in teacher education, and content methods courses in particular, are veritable lesson plan production factories. Semester after semester, students in teacher preparation programs develop units, identify resources, and write out detailed lesson plans that incorporate a range of engaging activities. And their well-organized notebooks all too often become another volume stored in a methods professor's filing cabinet or are lugged from school to school during the early years of the student's professional teaching career.

The Social Studies Program Area of the Curry School of Education at the University of Virginia has decided it is time to wed the productivity of its preservice teachers to the demand by practicing teachers for timely, useful, creative lesson plans and resources. It's a marriage, of sorts, made possible by the advent of the World Wide Web. Funded in part by a grant from the Virginia Foundation for the Humanities and Public Policy, the Social Studies Program Area has created the *Jamestown Virtual Colony* to serve as an online resource for teachers whose content includes the founding and settlement of Jamestown, Virginia. Soon after its inception, the project was recast not only as a service to high school history faculty but as the organizing framework for a collaborative themed approach to the training of preservice teachers and the enhancement of licensed teachers' leadership. The completed project represents the Curry School's first of what should be many web-based teaching resource units for teachers of history and social studies.

The Jamestown Virtual Colony

The primary purpose behind the *Jamestown Virtual Colony* Web site is to offer teachable lesson plans through the instant and mass distribution of the World Wide Web. The choices of content and concepts, and the state and national standards that inform the lesson plans' foci, are geared primarily to 11th grade United States History courses, although teachers of any level should find the site useful for creating and tailoring their own instructional activities. The lesson plans are integrated into a larger themed unit framework, which includes objectives, unit outlines, and annotated bibliographies. The content of the site is divided into five areas: Corporate Colonization, Development of Government, Organization of Society, Economic Matters, and Broader Themes of Jamestown. The daily lesson plans do not exist in isolation, but are supplemented by primary sources, images, maps, and reference works, as well as an exhaustive list of links to other relevant sites.

Teachers who access the *Jamestown Virtual Colony* will find more than the lesson plans and resources developed within our unit. They can also find lesson plans and guides developed by some of our Masters students for teaching with other online Jamestown resources. The site also provides some assistance with evaluating information found on the Internet, using search engines, and (coming soon!) a "virtual field trip" to Jamestown that permits online visits by those who would otherwise be unable to travel to the real Jamestown.

In keeping with the notion of the Web as a "dynamic environment" (Garland, Scott, & Boyer, 1995), and in seeking to take advantage of its interactivity, the area devoted to Links to Other Sites includes user-input forms so that visitors to the *Jamestown Virtual Colony* can add relevant links that they themselves have created or that they have encountered. A special section is devoted to class web projects. As more and more teachers involve their students

in "intellectual skills" projects, the World Wide Web is increasingly the vehicle used to publish student work. Teachers can add a link to their students' work directly onto the Class Projects page within the *Jamestown Virtual Colony*.

The Role of the World Wide Web

Educators of young children who wish to engage those children in the social studies must necessarily come to terms with the emerging roles of technologies in the development of society, and in the activities of contemporary teaching and learning (Gooler, 1995).

Much has been written about the incorporation of technology, computers, and specific applications in social studies teaching. While a great deal of the research about the effectiveness of computer applications in enhancing student learning has yet to reach definitive status, it is clear that computers can—and should—occupy a role in the preparation of children to assume their roles as good and productive citizens of tomorrow. Classroom teachers and students "who have learned to use these tools effectively have increased their ability to solve problems, accomplish tasks, and learn about the world" (Moursund, 1995-1996). We cannot neglect our duty likewise to prepare preservice teachers to effectively utilize technology in pursuit of educative goals. Kovalchick (1997) notes that as "the use of technology in teacher education gains greater attention, it's important that we continuously refine our models of technology instruction for preservice teachers."

Social studies and the World Wide Web are natural partners in the educational endeavor. In fact, it is the advent of the Web, particularly after the introduction of Mosaic and, later, Netscape, that has best exemplified why technology must find a suitable home within the social studies. There is no doubt but that the "resources made available by Internet access have tremendous educational potential" (Boldt, Gustafson, & Johnson 1995). While many "social studies educators have been reluctant to integrate computers into their curriculum and instruction" (Berson, 1996), an increasing number are recognizing the Web's particular value as a means for accessing information, a primary educative process in good social studies instruction. "Data Gathering," which is first among four skills deemed essential by the National Council for the Social Studies in 1990, is perhaps the most common activity engaged in by students in social studies classes.

What is the Web's beauty when it comes to gathering data? It has never before been possible to access the volume and array of primary sources as can now be found through a few clicks of a mouse button. And it is unfiltered content, without interpretation or revision by textbook authors or other third parties. In today's world, the delivery of a single newspaper to a few lucky social studies classrooms seems almost laughable when held up against the hundreds of newspapers from throughout the world that can be accessed online. The instant identification, reading, and tracking of Congressional legislation through Thomas [http://thomas.loc.gov/] puts students in direct contact with the legislative process. "White (1990) has noted: 'Interactive multimedia—the marriage of text, audio, and visual data within a single information delivery system [sic] represents a potentially powerful tool for teachers and students throughout the curriculum" (cited in Martorella, 1991). Images, maps, speeches, music, and video abound, and the hyper-navigability of the Web allows students and teachers to seek directly the content in mind while simultaneously pursuing connected areas of interest in the manner befitting their search. In other words, students and teachers can circumvent the middlemen and brokers of information in the truer spirit of social science inquiry. And one of the most valuable shifts in the expression of students' information-gathering skills might be, as Richard Diem put it, not finding the right answer but "asking the right question" (Diem, 1997).

Publishing the *Jamestown Virtual Colony* on the World Wide Web permits universal access to its resources. There is no reliance on traditional publishing and distribution systems of a physical product. The content can be updated and supplemented instantly, and sounds and images are as accessible as text documents. Teachers can hyper-navigate the site and thereby go directly to the target of their particular interest.

But what distinguishes non-technology-using teachers from effective users? There is reason to believe that better integration of technology training is needed in preservice teacher education. It is not only how tools are manipulated but *to what end* they are used that teachers should understand. The possibilities for technology in the hands of well-trained teacher education graduates "depends in no small measure on [having a] broad, deep, powerful, and empowering teacher education experience, supported by telecommunications technology" (White, 1997). Integrating technology into methods courses helps create the "cadres of reform-ready novice teachers who are able to harness technology's potential to transform education and schooling" (White, 1997).

Further, teachers need to see the usefulness of the Web and other technologies, not only for their "own professional growth," but also to see "how they can use these same resources to support the curriculum" (Fontana, 1997).

The Methods Component

Beyond the obvious benefits to United States History teachers that this online repository will represent, though, is the emergence of a remarkable model for the methods training of preservice teachers that includes a component of collaborative leadership by experienced Masters level students. Based on a thematic team design, the graduate

students managed and directed the curriculum development work of students in the social studies methods course and created the unit framework into which the preservice teachers' products fed. This represented the first time we had ever combined Masters students with undergraduate preservice teachers in order to enhance the learning outcomes for the Fourth Year students.

Designing instructional materials for delivery by the World Wide Web forces emerging teachers to confront some very frank issues: What is history? What should United States History offer to students? What characterizes good instruction? What characterizes a good lesson plan? What are the attributes and pitfalls of the World Wide Web as a resource, information source, or repository? The preservice teachers did not merely practice the crafting of lessons for good learning but attempted to resolve how one best develops an Internet resource for history teachers that is accessible, meaningful, and useful. Authenticity took a more central role as students sought to demonstrate their emerging understanding of good lesson planning. Because the students posted their early lesson plan drafts on their own personal home pages, we were able to institute a peer review process that led to useful revisions by the lesson plan authors *and* which called on students to seriously grapple with the components and qualities of good lesson planning as they attempted to provide constructive criticism to their classmates. Most feedback was given via email, but each student also completed a detailed rubric review guide [see the Appendix] for at least three of his peers.

The divisional responsibility framework was a unique way to honor the expertise of our Masters students, all of whom were licensed teachers with experience ranging from recent graduates with only a student teaching field experience to eleven years of classroom experience in New York. Their roles as team leaders called for them to better understand and then articulate their accumulated knowledge about teaching. Their guidance of the undergraduates' work was accomplished in regular meetings and through email communication.

As White (1997) notes:

> ...in a teaching field that places a premium on primary sources and inquiry, future social studies teachers ought to explore the range of resources available for their students and their own further education that telecommunications technology makes possible.... The potential benefits in reaching out to a wider world of resources makes experience in using telecommunications technology in preservice education particularly imperative for social studies teachers.

Some Caveats Worth Considering

While the development of the *Jamestown Virtual Colony* occupied a central role in the first half of our social studies methods course, this inaugural run of the model came with some limitations. First and foremost, the students who developed these lessons have not been asked to also teach them in real classrooms. Certainly, a trial run with opportunities for feedback and revision would allow for reflective adjustment in the structure and implementation of the lesson plan design. Second, because they are only in the fourth year of a Five-Year Bachelor of Arts/Master of Teaching program, these methods students are essentially novices in lesson plan writing. By the time they complete the second half of the methods course, their skills will be much improved and will find richer manifestation. But for many, this project was a first attempt at serious lesson plan writing for well-defined content and with an intended audience outside the faculty of the School of Education.

Third, as a new project without antecedent, the development of this online resource for teachers followed an emergent design. It was clear that working towards a goal which did not exist in any example form was for some students an unsettling experience. In truth, the wide latitude for creativity and the open-ended nature of individual lesson development were a difficult concept for some of the more anxious students.

Fourth, not all classroom teachers have access to the World Wide Web. Those who do have computers, modems, and communications and browser software are not necessarily "well-connected." DOS or early Windows versions of software, modems that are 14,400 bps or slower, and unsophisticated dial-in systems make web-surfing a treacherous and frustrating activity. We have very deliberately kept our site as low-impact as possible so that interested teachers would not become frustrated waiting for fancy graphics and large images to load.

Finally, it is not our intention to continue active maintenance of the *Jamestown Virtual Colony*. It will be left to exist in the form made final with our spring revisions, and the students and faculty involved will move on to other pressing projects. As of this writing, a decision is still pending as to whether the files will be moved to the Anthology History and Social Studies Pavilion on the Virginia Public Education Network (VaPEN), or if the site will be offered to the Jamestown-Yorktown Foundation to become a part of their outreach and education programs. The real benefactors, though, are the teachers who will now find a wealth of resources for teaching about the Founding of Jamestown. From our vantage point, the *Jamestown Virtual Colony* is a fitting tribute to the 400th anniversary of this settlement.

Future Implications

We gained much as teacher educators from this collaborative web-based project. It is likely that it will be a regular component of future methods courses. Students not only studied the theory and models of good lesson design but became critical consumers of their peers' lesson plans. Further, because their products will be offered to a world market of over 20 million computers, students seemed more intent on achieving a quality result from their labors. And the technology component in their preservice training should not be overlooked. The students in the methods course were immersed in web issues ranging from searching the Web to critically evaluating Web sites. They also were invited to expand their notions about the instructional applications of the Web and Web design. The real beneficiaries, though, are the teachers who will now find a wealth of resources for teaching about the Founding of Jamestown. From our vantage point, the *Jamestown Virtual Colony* is a fitting tribute to the 400th anniversary of this settlement.

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Appendix

EDIS 560: Teaching Social Studies
Fall 1997 — Mr. Bennett

RUBRIC *for* LESSON PLAN REVIEW

Outstanding 4 | Satisfactory 3 | Needs Improvement 2 | Missing or Insufficient 1

NAME of LESSON PLAN AUTHOR	TITLE of LESSON PLAN
THEME AREA that LESSON IS PART OF	NAME of REVIEWER

Lesson Components

The objectives are behavioral and measurable.	4	3	2	1
"Students will be able to..." do *something* as a result of, not necessarily as part of, the lesson.	4	3	2	1
The relevance of the lesson is clear and meaningful.	4	3	2	1
Involvement of the learners is well-connected to the activities which follow it. Its relevance is clear and logical.	4	3	2	1
The lesson plan functions to organize the content so that student understanding of new information can be enhanced.	4	3	2	1
There are central or pivotal questions that serve to get at the "heart" of the lesson, its big ideas, or its most important points.	4	3	2	1
Clear, specific, detailed, step-by-step instructions are provided to guide the teacher through each element of each activity of the lesson.	4	3	2	1
The activities of the lesson are engaging, creative, and innovative. They seem more "fresh" than "stale."	4	3	2	1
The activities, if well-completed, will lead to student achievement of the lesson's objectives.	4	3	2	1
A closure that brings everyone back together and which revisits the important points of the lesson is well-explained.	4	3	2	1
The closure encourages a "reflective" moment so that students may reexamine the important objectives of the lesson.	4	3	2	1

The closure is composed of appropriate questions.	4	3	2	1
ALL necessary materials are provided. It is clear what materials are referred to in the lesson (rather than saying "the handout," it is referred to by name).	4	3	2	1
Excerpts and quotes are appropriately cited. The sources of information are clear.	4	3	2	1
A bibliography of sources and resources is provided, with annotations.	4	3	2	1
Recommendations for evaluating or assessing student outcomes are provided. (These would tie directly into the objectives listed at the top of the lesson.)	4	3	2	1
The reviewer is not distracted by errors of spelling or grammar, unnecessary or cluttering graphics, or poor text presentation and organization.	4	3	2	1

Web-Based Presentation Issues

The layout and design of the lesson are orderly and sensible and adjust to varying screen sizes.	4	3	2	1
The presentation of the lesson online reflects the author/designer's knowledge of website evaluation (i.e., authorship is explicitly noted, date last updated is included, links back to main or referring page are provided, etc.).	4	3	2	1
All links work.	4	3	2	1
Navigation within and between lessons has been considered.	4	3	2	1
There are links for backing out of sub-pages and/or for moving forward to subsequent pages.	4	3	2	1
The title bar/top of page contains the title of the lesson, as opposed to "Lesson1.html" or "untitled."	4	3	2	1
Handouts, worksheets, etc., are included as separate pages which can be individually printed.	4	3	2	1

Open-Ended Questions

What is it about this lesson that makes it teachable?

What is it about this lesson that makes it difficult to teach?

Would you want to be a student having this lesson "done" to you? Is it engaging? Would it inspire you? Why or why not?

List at least four recommendations you would make about the appearance, design, and layout of this page.

The Community Discovered: An Early Review of One U.S. Department of Education Challenge Grant

Sherwood Dowling
National Museum of American Art,
Smitsonian Institution

The Community Discovered is a collaborative project sponsored by the U.S. Department of Education's Technology Innovation Challenge Grant Program. These grants are awarded for the purpose of developing and refining technological applications with the potential to make significant contributions to school improvement. *The Community Discovered* is one of nineteen projects awarded Challenge Grants in fiscal 1995. This Challenge Grant, awarded to Westside Community Schools in Omaha is a project that links art and technology with integrated constructivist curricula designed to transform the education of rural and urban disadvantaged students. The project features a collaboration between Nebraska public school districts and Nebraska museums. The Smithsonian's National Museum of American Art, the University of Nebraska at Omaha (UNO) and Prairie Visions are also principal partners in this effort. The Prairie Vision Consortium was established by the Nebraska Art Teachers Association and Nebraska Department of Education with support from the Getty Center for Education in the Arts, and includes over ninety public and private school districts in Nebraska. *The Community Discovered* builds upon and extends the impact of the *Art and Technology Integration Project* conducted by Westside, Grand Island, the National Museum of American Art, and the University of Nebraska at Omaha. The ATI project received a two year grant from the Nebraska Excellence in Education Council.

In addition to Westside Community Schools, currently participating Nebraska K-12 school districts include the School District of Grand Island, Lexington Public Schools, Winnebago Public Schools, and Omaha Public Schools. These participants represent a diversity of students including significant African American and Latino populations. Urban, suburban and rural communities that feed these school systems are comprised of families with a broad range of socioeconomic circumstances.

The U.S. Department of Education believes that the nineteen "Challenge Grant communities are likely to succeed because they have begun with a clear definition of the educational problems they want to address." (U.S. Department of Education, 1995). This paper presents an early review of the *Community Discovered* project describing progress toward that optimistic prediction and offers suggestions for improving chances of success.

Basic Concept and Goals

The Community Discovered is a five year project designed to link the use of technology and the visual arts with other subject areas throughout the K-12 curriculum with special emphasis on service to rural and urban disadvantaged students. A principal outcome of the project will be development of curriculum models of engaged student learning featuring activity based use of museum source materials made available electronically.

The Community Discovered project has five goals: 1) to promote and encourage academic achievement, 2) to provide student equity in access to state and national museum resources, 3) to enable educators to effectively use appropriate technologies for teaching and learning, 4) to effectively integrate art into interdisciplinary curriculum projects, and 5) to create a national network of educators to support the development and implementation of appropriate learning strategies that integrate art and technology into other subject areas.

Five related activities are designed to enable educators within Nebraska to participate in the accomplishment of these goals:

1) The Electronic Museum in the Classroom - digital images of museum artworks are being made available via Internet with information about each work and model curricula using the work. The National Museum of American Art, the Joslyn Art Museum (Omaha, NE), the Sheldon Memorial Art Gallery and Sculpture Garden

(Lincoln, NE), and the Museum of Nebraska Art (Kearney, NE) are currently participating. NMAA has also produced a CD ROM to provide access to museum art and information for students and teachers with personal computers, but without Internet access.

2) Computer-based Educational Strategies - educators are testing, using, and evaluating commercially developed software as part of an integrated curricula. Students use software as tools in the construction of meaning and as electronic portfolios to record their progress and demonstrate their understanding of content.
3) Professional Development and Support for Educators - selected educators participate in intensive summer workshops preparing them to use the visual arts and technology, to apply the constructivist theory of teaching and learning, and to integrate art resources into content areas.
4) Integrated Curriculum, Instruction, and Assessment Strategies - educators develop curricular units integrating Internet-based resources engaging students in an active learning process. Site-based coordinators will with development, implementation, and assessment. Project evaluation is proactive, providing guidance throughout the project.
5) Nationwide Community for Art and Technology Integration - in cooperation with Prairie Visions and NDE, the project is sharing curricula, the collaborative model, and pedagogical methods using ARTnet, a web-based resource developed to support the arts as a core subject in the K-12 curriculum.

Further information on *The Community Discovered* can be found at http://communitydisc.wst.esu3.k12.ne.us

An Early Review: What Are the Chances for Success?

The following discussion is not part of the project's formal evaluation being conducted by the University of Nebraska at Omaha. The formal evaluation is being conducted by the Office of Internet Studies, College of Education, University of Nebraska at Omaha. The UNO evaluation is an impact analysis focused on analyzing data related to the above project goals and to related project objectives. With a comprehensive approach to data collection, UNO is examining teacher survey data, electronic data such as website use, classroom observations and videotapes, teacher and student interviews, student progress reports and portfolios, and focus group discussions. Both quantitative and qualitative approaches are being used to summarize and analyze the collected data with conclusions and implications based on multiple sources of data.

For example - the UNO evaluation of Goal 1, " to enable students to achieve high academic standards in art and other core subject areas" is broken down into specific objectives such as Objective 1.1, "80% of students in classes using the modules will show evidence of improved academic achievement indicated by: a) decline in absenteeism, b) increased student self-concept, c) students performing at higher levels as determined by each school's assessment of student progress." Each sub-objective has associated activities such as "a) a longitudinal survey of student attendance records, b) an annual student attitude survey - open ended and Likert, c) standardized test information," identified instruments to measure the activities, and project staff responsible for data collection. For further information on UNO's formal evaluation, visit http://ois.unomaha.edu/.

While the work of the UNO evaluators has been incorporated into this review, the purpose of the subject paper is not to evaluate project progress for each of the above project goals. Rather, as pointed out by Donald P. Ely, a review of basic conditions that facilitate the adoption of educational technology innovations can help identify the need for new or changed policies (Ely,1990). By comparing more subjective information with informed observations from existing literature in educational technology and innovation diffusion, this review will provide an informed view of the project's overall chances of success as well as several recommendations for improving those chances.

The following review compares project progress and participant observations with criteria for success presented in *Technology and Educational Reform* by Barbara Means and Kerry Olson (1997) and by comparison with benchmarks found in innovation diffusion literature such as *Diffusion of Innovations* by Everett M. Rogers (1995).

What Factors Lead to Success in Educational Technology?

The following discussion is derived from *Technology and Educational Reform* (1997) by Barbara Means and Kerry Olson. This report is part of the ongoing Studies of Education Reform Program of the U.S. Department of Education's Office of Educational Research and Improvement and was based on case studies of nine schools that "emphasized education reform (rather than technology for its own sake) and that provide challenging, authentic activities for students." This emphasis is further explained by Means and Olson:

The experiences of our case study sites suggest that, in fact, the move to project-based work, without relying on lecture methods or following a textbook, is a more fundamental and difficult shift than the introduction of technology. Teachers who have learned how to design challenging activities in which students work on cooperative projects and who are able to manage multiple student groups working on different phases of their project activity find that the introduction of technology goes relatively smoothly. (Means & Olson, 1997, p. 68)

The report identifies the following characteristics as important in supporting such an environment: sufficient numbers of computers to allow for frequent access, strong leadership, a collaborative environment with shared instructional goals, extensive opportunities for teachers to learn and work with technology, and on-site technical support. A sufficient number of computers is defined as "enough for a quarter of the students working individually or half the class working in pairs." Leadership at the district level was categorized as instigation of innovation and in ongoing support with important activities being support for grant writing, use of bargaining and purchasing power, and nurture of reform activities. Importantly, the report also noted the negative consequences of top-down decisions with respect to restructuring and technology when first line educators were not involved. The most important element of leadership was identified as that of the school principal in inspiring and coordinating activities, in serving as a program advocate and liaison with the district, and in making technology supported reform a school wide effort. A collaborative environment with shared instructional goals is cited by the authors as fundamental to the successful integration of technology as teachers will be motivated to incorporate technology when it supports school educational norms. The importance of leadership and a collaborative environment resulting in a school wide vision are emphasized by Means and Olson:

> ... our case studies suggest that the greatest difference between more and less successful technology implementations resides in their artfulness in creating a coherent school wide approach to using technology in the core curricula for all students. (Means & Olson, 1997, p.116)

The authors identified these strategies for providing opportunities for teachers to learn and work with technology: create a cadre of innovators to start a snowball, seek agreement on technology role consistent with school vision, provide computers for teacher's personal use, reward instructional uses of technology, adopt technology skills goals, provide supported time for learning to use technology and design of instructional applications. Finally, Means and Olson identify five kinds of necessary technical assistance: help in planning for technology uses and acquisitions, training in how to use new hardware and software, demonstrations and advice on how to incorporate technology into instruction, on-demand help when software problems or hardware failures arise, and low level system maintenance.

This excellent report also provides information on resources for technology implementations, ways that technology supports project based learning, effects on students and teachers, and much more. The last chapter, reporting implications for policy, practice, and research, identifies five features associated with success: time devoted to developing a school wide vision, adequate technology access for all students, time for teachers to learn to use technology and to incorporate it into their own curricular goals, easily accessible technical support, and rewards and recognition for exemplary technology supported activities. Means and Olson conclude with the following features associated with successful applications - the most fully developed projects: had strong curricular content and many components that were not technology based, provided a structure within which teachers could innovate, provided an opportunity for teachers to collaborate with peers, involved students and teachers already familiar with the project based approach, and involved use of technology across subject matters and classrooms.

For the purposes of this paper, information in *Technology and Educational Reform* by Barbara Means and Kerry Olson, as discussed above, have been abbreviated as the following indicators of success:

- preexistence of project based approach,
- sufficient numbers of computers to allow for frequent access,
- administrative support by district,
- nurture of reform activities by school principal,
- coherent school wide approach to using technology in the core curricula,
- supported time for learning to use technology and design of instructional applications,
- easily accessible technical support,
- rewards for exemplary technology supported activities,
- strong curricular content,
- use of technology across subject matters and classrooms,
- structure within which teachers can innovate,
- opportunity for teachers to collaborate with peers.

What factors lead to the successful adoption of an innovation?

While *The Community Discovered* is certainly an educational technology project as described by Means and Olson, it can also be viewed from a more general perspective - as an "innovation." Successful adoption of innovations is generally recognized by their "diffusion" throughout a target culture. The study of innovation diffusion, pioneered by Everett M. Rogers, is a relatively new discipline by academic standards. The following discussion is largely drawn from Roger's seminal work, *Diffusion of Innovations* (1983). Rogers defines diffusion as:

> ... the process by which an innovation is communicated through certain channels over time among the members of a social system. It is a special type of communication, in that the messages are concerned with new ideas. (Rogers, 1983, p.5)

Rogers defines four main elements of innovation diffusion: the innovation, communication channels, time,

and the social system. An innovation, per se, is an idea, practice, or object that is perceived as new by the potential adopter. The characteristics of innovations, as perceived by potential adopters, explain from 49 to 87 percent of the innovation's rate of adoption. Characteristics identified by Rogers include: relative advantage, the degree to which the innovation is perceived as better than the status quo; compatibility, the degree to which the innovation is perceived as consistent with existing values, past experiences, and needs; complexity, the degree the innovation is perceived as difficult to understand and use; trialability, the degree to which the innovation may be tested prior to adoption; and observability, the degree that adoption results are visible to others. Rogers states:

> Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations. Past research indicates that these five qualities are the most important characteristics of innovations in explaining the rate of adoption. (Rogers, 1983, p.16)

Since diffusion is defined by Rogers as a special type of communication, communication channels are obviously an important aspect of successful adoption. Mass media channels are recognized as the most rapid and efficient means of creating awareness; however, interpersonal channels, particularly peer to peer, are identified as more effective in promulgating adoption. Rogers indicates that:

> ... investigations show that most individuals do not evaluate an innovation on the basis of scientific studies of its consequences, although such objective evaluations are not entirely irrelevant, especially to the very first individuals who adopt. Instead, most people depend mainly upon a subjective evaluation of an innovation that is conveyed to them from other individuals like themselves who have previously adopted the innovation. (Rogers, 1983, p.18)

Rogers breaks the time dimension of the diffusion process into five steps: knowledge, persuasion, decision, implementation, and confirmation. During this process, the type of decision (optional, collective, authority) influences the rate of adoption. For example, if the head of an organization decides to adopt an innovation, the adoption rate will be faster than one dependent on organizational consensus. From a system perspective, an innovation's rate of adoption is generally depicted as a traditional S-shaped curve, representing the number of adopters over time. The slope is characterized by Rogers as consisting of innovators, early adopters, early majority, late majority, and laggards.

The focus of much innovation diffusion research is the social system, defined by Rogers as "a set of interrelated units that are engaged in joint problem-solving." Actors within the social system, particularly those identified as change agents and opinion leaders, are generally recognized as key figures in effecting innovation diffusion. While rate of adoption is, to a degree, a function of change agent effort, success is also related to a change agent's client (service) orientation. Opinion leaders are those members of the social system who are consistently able to influence (formally or informally) other members attitudes and behavior. According to Rogers:

> The greatest response to change agent effort occurs when opinion leaders adopt, which usually occurs somewhere between 3 and 16 percent adoption in most systems. The innovation will then continue to spread with little promotion by change agents, after a critical mass of adopters is reached. (Rogers, 1983, p.208)

Group norms, organizational structure, formal/informal communication patterns, mutual discourse, incentives, and involvement by an "innovation champion" are also recognized by Rogers as affecting an innovation's rate of adoption.

In summary, the key variables identified by Rogers as determining an innovations rate of adoption are: perceived attributes (relative advantage, compatibility, complexity, trialability, observability), decision type (optional, collective, authority), communication channels, nature of the social system, and extent of change agent's promotion efforts.

For the purposes of this paper, information in *Diffusion of Innovations* by and Everett M. Rogers, as discussed above, have been abbreviated as the following indicators of success:

- relative advantage - economic, social, convenience, effectiveness, satisfaction, etc.,
- compatibility with existing values,
- ease of adoption,
- no risk testing,
- visibility of success,
- authority decision to adopt,
- information (reduction of uncertainty),
- reduction in change agent/client communication barriers (elimination/adoption of jargon),
- frequent peer to peer communication,
- extent of change agent effort in contacting clients,
- extent of change agent orientation to clients,
- adoption by opinion leaders,
- involvement of an innovation champion.

What Other Factors Lead to Success?

Subsequent to Rogers' initial publication of *Diffusion of Innovations* a number of researchers have contributed insight into the innovation diffusion process. In a meta study of knowledge diffusion / utilization generalizations, Thayer

and Wolf (1984) report that diffusion of educational innovations is largely parallel to innovation diffusion in other domains. Thus, a selected review of diffusion literature was undertaken to reveal additional indicators of success.

In a study of twelve schools implementing educational innovations, Huberman and Miles (1984) found several factors associated with early success: degree of preparedness and user commitment, sufficient resources and materials, understanding of the new practice, prior experience and ongoing aid. Of particular note, *ongoing aid and inservice training* were instrumental at rough-starting sites and seemed especially beneficial at sites that turned out later on to be the most change-inducing and the best institutionalized." They also found that results improved when such assistance was associated with the original project design:

> At our sites, adaptation always took place - but it was sometimes constrained by administrators' stout refusal to permit adaptations that would weaken or water down the innovation. Enforcing fidelity for substantial, good-quality innovations really paid off - if it was accompanied by effective assistance. When adaptation went too far because of administrative "latitude," what often occurred was blunting or downsizing, trivialization, and weak student impact. (Huberman & Miles, 1984, p.279)

In a later study of school improvement strategies employed in ten states, Anderson, et al. (1987), define high quality teacher training as theory driven and also recognize the importance of creating a "cognitive frame common to teachers and administrators," one that supports the principal as a knowledgeable leader.

In a much cited review of the diffusion of the use of tetracycline, Burt (1987) found evidence that diffusion was fostered by physician perception of innovation adoption as the action proper for an occupant of their position.

Ely's review of the literature reinforces many of the above findings, particularly those of Means and Olson. Ely does specify time as a distinct resource (1990):

> Good time. Company time. Paid time. Implementers must have time to learn, adapt, integrate, and reflect on what they are doing. ... Teachers need time for inservice training; they need time to revise existing teaching plans; they need time to practice with new materials; they need time to try out and evaluate new teaching procedures. In short, time is a vital element in the total process of educational change. (Ely, 1990, p. 300)

In a study of suburban elementary school educators, Albrecht and Hall (1991) found that communication about new ideas tended to occur within "strong, multiplex relationships" dominated by "elite" groups of individuals:

> ...talk about new ideas and innovations is simply not a widely shared experience among organization members, despite prescriptive admonitions to the contrary. (Albrecht & Hall, 1991, p.556)

Curry (1992) explains the thinking that innovative organizations are learning organizations in which members are provided information upon which they act collaboratively, members are minimally defensive toward others, mutually supportive group dynamics exist, and participants have high freedom of choice to engage in risk taking. Learning oriented norms and strong internal commitment are typical of such learning organizations.

In an extension of Burt's methodology, Kearns (1992) added frames of reference to the actor's position within the communication network to establish a "sociocognitive network approach" to the study of innovation diffusion. Kearns' frame of reference is the "cognitive map" of the potential adopter incorporating underlying assumptions, values, and belief systems. Consistent with Rogers' assertion that the perceptions of potential adopters are as important as the facts about an innovation and Burt's description of structural equivalence, Kearns argues that the best predictors of adoption are the actions of "boundary spanners," those people in the system who interact with people outside their system:

> ...strategies for disseminating new products and procedures should seek to take full advantage of sociocognitive boundary spanners, particularly sociocognitive brokers. These actors apparently are capable of speaking several "languages," and thereby providing an important link among a diverse group of innovation stakeholders. (Kearns, 1992, p.65)

In an analysis of cultural factors associated with innovation diffusion, Strang and Meyer (1993) suggest the importance of intellectual models that permit diffusion of theory rather than specific practices:

> ... diffusion should be most rapid where theorization is central to the construction of both units and specific elements, where partial theorizations articulate with each other, and where a network of congruent theories forms a hegemonic cultural frame. (Strang & Meyer, 1993, p.500)

In connection with institutionalization of theoretical models, Strang and Meyer also emphasize the empowerment of "actors" to carry the "ultimate values" inherent in the innovation.

While many of the above factors overlap and reinforce previous findings, for the purpose of this paper, the following factors for success have been added:

- inservice training consistent with and supportive of original project design,
- promotion of the attitude that innovation adoption is the professional thing to do,
- good time, company time, paid time for participants to implement innovation,
- expansion of group communicating about innovation,
- mutually supportive group dynamics that permit risk taking,
- support interaction with outside educators already proficient in innovative practice,
- explicit theorization is an integral part of innovation,
- inservice instruction in underlying theory for educators and administrators.

An Early Review of The Community Discovered

The Community Discovered as an innovation, was compared with the above factors for success to determine areas where project partners could take action to strengthen diffusion efforts. Information was collected through participant survey, interviews and direct observation. While the following observations often pertain to all five school districts currently participating, it is recognized that Omaha Public Schools has been a participant for less than six months and the author has limited evidence to support specific recommendations in this respect.

Means and Olson identified the preexistence of a project-based/constructivist approach as the most fundamental and difficult aspect of educational reform*The Community Discovered* is based on the premise that such an approach will be used; however, in only one district is such an approach widespread. Other districts have adopted a project-based approach to some degree, particularly in elementary grades; however, in one district classes are traditionally content driven. As one respondent reported; "sometimes I wonder if those high school teachers know there are k-i-d-s in the room!" Given the findings of Anderson, et al. as well as those of Strang and Meyer, it appears that the project would be well served by specifically emphasizing constructivist theory. This conclusion is supported by participants who rated the presentation by J. Brooks and the modeling and clarification of the constructivist approach as the most valuable aspects of the June '97 inservice. Unfortunately, it must also be reported that the same participants rated "too many theories" as a least favorable aspect; perhaps innovation theorization is best provided in small doses. The project director has initiated a newsletter and a modest article on the project's underlying research base in each issue may, without being burdensome, reinforce inservice provided by recognized experts such as Brooks.

Means and Olson also indicated that the more successful technology implementations generally occurred where a school wide approach to using technology existed. Consistent with this finding, they also cited the leadership of the school principal as fundamental. The school districts participating in *The Community Discovered* all have district technology plans or rubrics; however, it is not clear that district plans have been implemented on a school by school basis. Many of the participants' principals understand the project, a number of the principals support participant time and collaborative efforts, and many do not inhibit participant activities. Unfortunately, as currently administered,*The Community Discovered* does not engage school principals and, consequently, their support is superficial. Even in the district where the project-based approach is widespread, a respondent reported that upon observing students participating in small group activities, one principal left the classroom commenting that "I'll come back to observe another time when you are teaching." Respondents in another district reported that only one third, or less, of the districts principals even understood reform activities. It seems clear that even if the immediate goals of the project are met, no lasting impact will be achieved without the ongoing commitment to reform by school principals. To that end, participants' principals should be invited to become active in the project, receive their own inservice training, and proactively collaborate in achievement of project goals.

While no participating school has one computer for every four students (as Means and Olson suggest), with the exception of one district where computers are limited to the media center, there appear to be sufficient numbers of computers. The level and quality of technical support varies from district to district, but does not appear to be problematic. Only one district explicitly rewarded exemplary technology supported activities (through a technology factor in merit pay); however, several districts paid registrations and/or conference expenses for teachers making presentations at educational technology conferences and intrinsic rewards such as having class projects featured at parents' nights were widespread.

The above factors for success were inconsistently present from district to district and from school to school. However, there was one factor that was consistently lacking - time. Participants unanimously agreed that too much personal time was required to plan project-based activities involving art integration and technology. Even when funds are available for substitutes other factors often mitigate against supported time. Participants often used evenings and weekends for project related work and several respondents suggested that a portion of funding budgeted for substitutes be repurposed to compensate for those hours. Certainly, no activity is sustainable in the long run if people are expected to commit significant amounts of personal time on an ongoing basis.

Rogers indicated that the greatest response to change agent effort occurs when opinion leaders adopt the innovation. It appears that some *Community Discovered* participants, often characterized as "risk takers" during the first year of the project, can now be described, to some extent, as opinion leaders. Unfortunately, this transformation has been gradual. One explanation for the slow rate of adoption by opinion leaders is the level of effort by each district's primary change agent, the "site coordinator." Although supported by project funding, site coordinators often have numerous non-project responsibilities. The project's rate of innovation diffusion should increase if school opinion leaders are identified and recruited and, to the extent possible, site coordinators are free from non-project responsibilities. To that end, an excellent suggestion by one member of the UNO evaluation team was for site coordinators to participate in creation of model curricular units and thereby "serve as a metaphor" for project participants.

Rogers identified interpersonal communication, particularly peer to peer, as most effective in promoting adoption. Subsequent work by Burt, Albrecht and Hall, and Kearns emphasize the need for "strong, multiplex relationships" involving "boundary spanners." *The Community Discovered* is ideally situated to foster such peer to peer relationships. Participants in the June '97 inservice intuitively recognize this need citing the need for increased interaction with members from other locations. Given the distances between participating school districts, the use of communications technology is explicitly recognized as part of the model being tested by *The Community Discovered* and, currently, the project listserv is the primary inter-district means of communication. While other technologies such as video conferencing should be explored to facilitate the building of strong multiplex relationships between participants from different districts, it should be recognized that nothing will replace the value of peers meetings face to face. Workshops at regional partner institutions, such as the recently adopted special interest group meetings, may foster the rich interrelationships that promote innovation diffusion.

Another aspect of communication that is a factor for success is the visibility of success framed as professional success. One UNO evaluator recognized many successful classroom applications and pointed out that "good models were not being disseminated." The project director has addressed this issue and the newly undertaken project newsletter should serve as a means to recognize professional success and to disseminate model applications.

Comparison of The Community Discovered with factors for success resulted in the following recommendations:

- continue theoretical inservice training for new participants by experts such as Brooks - include/add similar training for participants' principals,
- increase educational reform efforts that emphasize the project-based/constructivist approach in several districts,
- in each project newsletter include a modest article on the project's underlying research base,
- work with each district to propagate district technology plans through each school, engaging the principals in substantive aspects of the project,
- seek technology partners that will provide additional computers and a local area network for the district currently limiting student computer use to the media center,
- ask each participating district to feature a classroom application in each newsletter - with these serving as "nominations," recognize exemplary applications through annual awards presented at the spring meeting,
- with funding currently allocated for substitutes, give district administrators the option of compensating participants for evening and weekend project work,
- work with district administrators to free site coordinators from non-project related responsibilities and provide them with inservice specific to their role as change agent, and
- foster strong, multiplex relationships among participants through all available means - expand workshops at regional partner institutions, leveraging their capabilities and increasing their role in the project.

With the exception of the universal need for supported time to work on project activities, factors for innovation diffusion success were present/lacking to different degrees in different schools. Similarly, many of the above recommendations are more/less applicable to different schools. While this finding is a matter of common sense, it is also recognized in the innovation literature. In an extension of Burt's model of structural equivalence, Strang (1991) incorporates a priori notions about social structure in an investigation of decolonization and argues that diffusion occurs within regions rather than empires or the world system as a whole. In terms of *The Community Discovered*, this hypothesis not only explains the differences in adoption patterns between school districts when other factors are consistent, but argues that project administration and resources should be applied differently in each district.

The Community Discovered is an ambitious project. With an activity-based/constructivist approach, integration of the visual arts, and use of technology as integral factors, the project has been characterized as three projects in one. Most participants recognized the importance of a holistic approach and changes to the project's basic structure are not recommended.

Huberman and Miles point out that educational innovations that are adopted smoothly are generally "midgets making few local demands" in contrast with rough implementations characterized as "ambitious, change-inducing, and organizationally difficult."

> In terms of desirable outcomes, smooth early use was a bad sign. Smoothly implementing sites seemed to get that way by reducing the initial scale of the project and by lowering the gradient of actual practice change. This "downsizing" got rid of most headaches during the initial implementation but also threw away most of the potential rewards; the project often turned into a modest, sometimes trivial, enterprise. By contrast, most of the initially rough-implementing projects, including those that later produced the strongest outcomes, remained ambitious, change-inducing, and ill-fitting, all of which made for difficult initial use, but could deliver significant practice change. (Huberman & Miles, 1984, p.273)

This message is consistent with Ehrmann's (1997) premise that to make visible improvements in learning using technology, you must undertake large scale changes in methods and learning resources and it bodes well for the long term overall impact of the project.

While the sometimes rough initial implementation of *The Community Discovered* has frustrated participants in different ways in different places, any overall assessment must recognize the project's significant progress in moving from the conceptual stage toward broad implementation. The above review supports the project's basic direction and has revealed no problems inconsistent with a review of educational innovation literature. Recommended changes are modest, intended to further diffusion efforts.

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Social Studies Connections: Exploring Cultures through the World Wide Web

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Using the World Wide Web (WWW) as a research tool is an innovative and encouraging way for preservice teachers to make inquiries into and acquire information about different cultures. As a telecommunications tool, the WWW quickly connects people and ideas across distances and time via the Internet. That one can access information files, worldwide, is a novel idea to many educators and preservice teachers even if they understand the importance of computers in society. While computer hardware and software are available in classrooms, teachers and preservice teachers need time and the research skills to efficiently locate information relevant to a particular topic. For instance, students in a fifth grade classroom studying a particular culture, such as Aborigine, Cherokee, Ibo or Welsh, need guidance in locating information relevant for their research. In many ways, this is new learning for both students and teachers. From an inquiry perspectiv the need for information triggers a search based on the individual student's goal. Given the nature and scope of the WWW information sites, instructors must set parameters and provide guidance to enable learners to attain goals. This paper describes implementing a "culture box" activity designed to "identify different cultures" (Barth, 1991, p. 83) in conjunction with an electronic version of a culture box called a "cyber cube" (Jones, 1997) , a useful method of inquiry via the WWW.

Telecommunications in the information age appeal to students because of their familiarity with digital technology and because of the easy access to information and people. A student having Internet access and a level of technical expertise can use hypertext commands to create links to files on machines all over the globe. Given the increasing volume of information and the wide range of sources accessible to students and teachers alike, an important responsibility of educators is to teach students to critically evaluate information (Gilster, 1997; Caruso, 1997; Cole Slaughter & Knupp, 1995). In teaching the integration of research skills into elementary social studies classes, I can observe preservice teachers' fascination and excitement as they use Internet addresses to visit specific WWW sites for information about a specific culture. One student's comments reflect two critical elements inherent in Internet use - discovery and enjoyment: "I just learned how to use the Internet this semester, and I am constantly looking for lesson plans and articles. The Internet for research purposes is an excellent tool.". The same student, accepting an assignment to learn about a contemporary member of the Cherokee group through research, wrote her reflections:

> When I began my research project, I had no idea of Wilma Mankiller. Usually, when I start a project, I have some idea about the research topic. Not knowing about my topic made the project more fun. I used my new knowledge of how to use the Internet to do my research. I really like using the computer because the information is up-to-date. Also, you can obtain either in-depth information or a brief overview of what you are researching. I also liked being able to get a picture of Wilma Mankiller so I could actually see whom I am researching.

Using the WWW to explore cultures provides preservice teachers the opportunity to participate in an inquiry and reflective process. It was discovered that students can visit the following sites to find information about Wilma Mankiller:

http://www.powersource.com/powersource/gallery/people/wilma.html
http://www.library.okstate.edu/about/awards/winners/mankill.htm
http://www.cis.yale.edu/ydn/paper/4.26/4.26.95storyno.KB.html
http://don.skidmore.edu/~ptroscla/wilma.html
http://www.smsu.edu/contrib/news/releases/aug97/convoc.html
http://www.emporia.edu/N/www/theme/gender.htm
http://nativeamericas.aip.cornell.edu/

Reflections about the Culture Box

Studying the language, messages, educational practices, customs, and ways of life of people from various localities deepens knowledge and understanding of social problems as well as similarities and differences among people and environments. In our social studies classroom we learn the meaning of culture through a culture box/basket activity and a videotaped presentation which deals with culture from an anthropologist's perspective. A culture box/basket is used in a learning activity that allows individuals to select from it information, artifacts or objects, and through these, to tell the audience something about themselves. The choice and discussion of culture box/basket contents illustrate a person's philosophy, beliefs, process of decision-making, reflective thinking, creativity and communication skills. Through these impressions of culture, elementary preservice teachers from a predominately white culture are exposed to cultural diversity as a human and environmental experience. Having participated in the culture box/basket presentations, a preservice teacher wrote the following journal entry:

> This particular activity was very insightful because in a few short moments we were able to learn so much about all of our classmates. I think this is a useful activity to get people to know each other. Also, it could help to relieve any anxieties that people may feel when they are introduced into a new setting.
>
> From an instructor's perspective, using a culture box/basket activity and group discussions about constructing the culture box/basket provide a learning environment that is non-pressured, interactive and multisensory. The preservice teacher continues to reflect in his journal about the value of this activity:
>
> I think the most interesting things that people brought were items representing hobbies. This gives all of the students in the class an opportunity to actually see and touch something which is representative of that activity and that is better than just hearing about it. Also, I think this is an excellent activity to do in an elementary school because the students can learn so much while having fun and wouldn't even recognize it is actual learning.

Barth (1991) suggests that the social studies culture box designed for children in second grade enables learners to gain knowledge about different cultures through effective strategies such as integrating, reinforcing and accommodating information.

In a social studies classroom that integrates technology in the curriculum the transfer value of a culture box/basket presentation is substantial. When preservice teachers are given an opportunity to use the WWW to research a topic they develop knowledge and skills about culture and technology. The teacher is able to observe the ways in which learners can acquire information about different cultures through exploring the WWW.

For instance, by incorporating the information site - http://homepage.third-wave.com:80/educate/me.htm - created by a graduate student, elementary preservice teachers are exposed to new educational technology and concepts embedded in content, such as hypertext, links, integrated learning, critical thinking and cultural diversity. Using this strategy, preservice teachers can connect their learning experiences from presenting a culture box/basket to a different style of learning with the computer generated "cyber cube."

Individually, preservice teachers are able to assess their educational needs for professional growth . For example, a nontraditional preservice teacher said:

One of the more attractive features of the presentations is the kinetics of article illustrations - this way students can visually experience information. I realize I need more exposure to new technology. I learned that I have a great deal to learn about progressive technology to be effective in educating my students to meet the challenges of the Twenty-first Century.

The ability to self-evaluate and choose, coupled with the novelty of accessing WWW sites and links to additional information sources, is evidenced in reflective comments from a student who has "just learned to use the Internet:"

It is pretty impressive to look at what people can create on the Internet. I thought the computer-generated culture box said a lot about the person. It said he is intelligent and competent in the area of computers. This would not be an appropriate thing for me to do since I only know the basics about computers. I personally enjoyed the class presentations of culture boxes. To me, it is more intriguing to see and feel actual "stuff" than the images on a screen. I may use the culture box/basket to introduce myself in my student teaching experience.

Guided Resources

Having grasped the meaning of culture from the classroom presentations, preservice teachers use various Universal Record Locators (URLs) that lead to information about a specific culture. For example, studying Australian culture, and, in particular, the Aborigines with classroom Internet access, preservice teachers explored the following URL's to learn about language, art, prehistory, botany and geography:

Australia

Australian Aboriginal people language
http://www.atsic.gov.au/regions/cairns.htm#language

Australian Aboriginal art:
http://www.geocities.com/Vienna/4259/abor-art.html

Australian Aboriginal Prehistory
http://rubens.anu.edu.au/student.projects/tools/Prehistory.html

Koori Center, University of Sydney
http://www.koori.usyd.edu.au/

Kumbari Ngurpai/Lag Higher Education Centre, University of Southern Queensland
http://www.usq.edu.au/kumbari

Australian Aboriginal writers
http://home.vicnet.net.au/~ozlit/aborigwr.html

Australian National Maritime Museum Galleries
http://www.anmm.gov.au/gallery.htm

Australian National Botanical Gardens
http://155.187.10.12:80/anbg/index.html

Australia's bio-diversity:
http://life.csu.edu.au/biodiversity.html

Australia's landscape ecology & bio-geography
http://www.csu.edu.au/landscape_ecology/landscape.html

Australia Continental Map
http://155.187.10.12:80/images/maps/australia.gif

Australian/Tasmania geography, demographics, national parks & general information
http://www.csu.edu.au/australia/geograph.html

Conclusion

Making connections with culturally diverse groups using culture box/basket presentations and technology requires resources. Preservice teachers select the items about their ethnicity and cultural heritage (s) or travels to create a culture basket or a "cyber cube." For students unfamiliar with the idea of a culture box/basket, using the electronic version of a culture box provides a model to construct the contents for a culture box/basket. Just as important is the guided exposure to WWW sites. For some individuals, going on a computer journey is adventuresome whereas others will find the process intimidating. In any case, educators cannot ignore the trend toward greater familiarity with new technology among today's students. This trend is supported by our observations of technology use among preservice teachers who integrate technology in planning instruction and classroom presentations.

We believe that exploring cultures through the WWW and encouraging preservice teachers to interact with an electronic "culture box" provide social studies multisensory, multi-modal learning. Preservice teachers are able to transfer knowledge from social studies coursework to the classroom and into the global environment. The process models inquiry methods and integrates technology in the content area. Each student produces information about a culture, analyzes connections across cultures, and uses links to world sites to enhance their knowledge.

Furthermore, students always choose the items to include in a culture box/basket. They choose the best way to organize family photographs, documents, maps and items that enable them to speak about themselves, their beliefs, relationships, environments and travels. For participants in the course, learning involves seeing, listening, touching, smelling, tasting, asking questions for more information, or making a comment. Because each student must think about the culture box contents, choose the items to share, organize an oral presentation or textual information in an electronic version, the classroom environment reflects openness. In the social studies classroom, preservice teachers explore shared ideas about a strong sense of family and community.

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Addressing the Social Studies Standards Through Internet Connections

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With the demands of the ever-changing society and the world, teaching social studies today is a challenge for teachers. Documents of reform like Goals 2000: Educate America Act and Curriculum Standards for Social Studies (1994) call for a different type of social studies than most of the preservice teachers have experienced in their own educational experience. Furthermore, the National Council for the Social Studies (NCSS) in its standards for the preparation of social studies teachers emphasizes the need for deliberate planning in the social studies:

> ...courses in social studies methods should prepare prospective teachers to select, integrate, and translate knowledge and methodology from history and social science disciplines in ways appropriate to students in the school level they will teach and give attention to the goals unique to the social studies and those shared jointly with the other areas of the school curriculum. Students should also be able to teach social studies utilizing a variety of curriculum approaches and in different types of settings (1992).

To prepare teachers for the future, we must model the use of technology as a tool to connect the social studies to the world in ways that are relevant to the students. To meet the current demands, the Internet provides resources to connect to the most current information in the field as well as direct access to historical documents.

What role can the Internet play in social studies classrooms? The value of the Internet lies in its user. The computer environment offers equal and sometimes greater control and flexibility to young children (Clements, Nastasi, & Swaminathan, 1992). Computer-based telecommunications through the Internet and online services afford a tremendous potential for social studies classroom now and in the future for students to become active learners. By providing this hands-on classroom experience with technology, students gain skills and knowledge necessary for personal, professional, and civic productivity. Using the Internet stimulates curiosity and eagerness to learn through immediate availability to infinite resources. By exposing preservice teachers to current potential of the Internet, access is available for up-to-date information and resources needed to teach social studies.The Internet provides unique opportunities for teachers and educators to collaborate, learn from one another, and to access and retrieve information. Connecting to the world via the Internet transports teachers and students beyond the traditional barriers of classroom or building.

Preservice teachers use the Internet to find resources for a thematic unit, a requirement in the social studies methods course. Since the preservice teachers are introduced to the Internet in a curriculum course that precedes the social studies methods course, they can further explore the possibilities for Internet resources of lesson plans, primary sources, virtual field trips, documents, and data collection. As the preservice teachers maneuver through the innumerable links, they interact with online resources. The preservice teachers then integrate Internet materials and/or activities found into their social studies units.

Internet locations to meet the ten themes that form the framework of the Social Studies Standards include resources for teachers and interactive locations for students to become involved citizens. Some examples of Internet resources that address the themes of the framework of the social studies standards are:

I. Culture

Through the exploration of web locations, students can compare and contrast the cultures of many areas of the world.

The Smithsonian

http://www.si.edu

This location links students to the 16 Smithsonian museums and the National Zoo as well as the history of the institution. The graphics help bring this online tour of the Smithsonian to life. The exhibits of the Smithsonian provide examples of culture from many areas of the world.

Indigenous Peoples of Latin America and South America

http://www.lanic.utexas.edu/la/region/indigenous

Investigate the customs, culture, and people of Brazil, Ecuador, Mexico, Chile, Bolivia, and other countries. Links

are provided to the Center for World Indigenous Studies and other international resources.

II. Time, Continuity, and Change

Through exploration of Internet sites students can examine their historical roots and locate themselves in time.

National Museum of American History Homepage

http://www.siledu/nmah/

The collection contains more than 17 million artifacts of the nation's heritage in the areas of science technology, and culture. Innumerable artifacts of everyday life including the Star-Spangled Banner (the flag), Edison's phonograph, early digital and electronic computing machines. A timeline is included that covers the history from 1500 to the present visually providing examples of history and technology throughout the history of the nation.

III. People, Places, and Environment

The locations chosen for this theme assist students in relating to the past and to determine where they are located in relation geographically to other people.

The Census Bureau

http://www.census.gov

Students can examine information about any city in the US. Census data helps students discover the needs of the people of the city which they might wish to address. Population data will answer questions for students about the number, ethnicity, and age of people. Relevant subjects include: county and city data book, county profiles, economic information, household economic statistics and voter registration.

City.Net

http://www.city.net/

Check on cities all over the world by clicking on the region of the globe that leads to specific countries and major cities.

Map Quest

http://www.mapquest.com

Children can visit the small towns and cities of our country. They can plot an imaginary school bus trip to each location from their own hometown by using Trip Quest. This feature provides city-to-city directions and interactive maps.

IV. Individual Development, and Identity

Explore locations about culture, psychology, and groups to discover how we develop our personal identity.

Interesting Dates in Black History

http://www.ai.mit.edu/~isbell/HFh/black/bhist.html

This source provides interesting facts about the history of African Americans.

Native American Resources on the Internet

http://hanksville.phast.umass.edu/misc/NAresources.html

This comprehensive list of Native American resources on the Internet links to categories such as museums, artists, archaeology, legal, music and bibliographies.

V. Individuals, Groups, and Institutions

Locations on this theme allow students to examine ways individuals, groups, and institutions play integral roles in people's lives.

League of Conservation Voters

http://www.lcv.org/lcv96/

The League of Conservation Voters has published a National Environmental Scorecard every year since 1970 to provide information about the voting records of the members of Congress. Scorecard represents the consensus of experts from 27 environmental groups who have selected the key votes on which members of Congress should be graded.

VI. Power, Authority, and Governance

Web addresses that assist students focus on the historical development of power, authority, and governance.

The Constitution

http://www.1m.com/~cjp/whig/Constitution.html

This location provides the complete text of the Constitution of the United States and the amendments. By using this site students can explore the document to make discoveries about the electoral college.

The Jefferson Project

http://www.voxpop.org/jefferson/

The Jefferson Project is a comprehensive directory of online politics. Included are mailing lists of web pages for the White House and all members of Congress. Two features include Netgrams and The Zipper. The Zipper allows you to enter your zip code to determine the members of the House and the Senate that represent you. It also allows you to communicate directly with any member of Congress and the President via email or visit their home page.

Thomas

http://thomas.loc.gov

This site is a service of the U.S. Congress through its library. Floor activities are published each week. Major legislation by topic and bills by number that are enacted into law, and bill texts from the 103rd and 104th Congresses are available. Committee reports and home pages for members of the U.S. House and Senate are included. Historical documents, such as the Declaration of Independence and the Constitution are accessible at this location.

Welcome to the White House

http://www.whitehouse.gov/WH/Welcome-plain.html

The White House location provides a variety of information about the President and the Vice President, the Virtual Library containing White House documents, audio speeches, photos, and White House for Kids sections containing helpful hints for young people to become more active and informed citizens.

VII. Production, Distribution, and Consumption

Students can explore resources to gain information about the factors of production, goods and services, as well as gain experience understanding about the U.S. National Debt.

Economics Resources for K-12 Teachers

http://ecedweb.unomaha.edu/teach.htm

This economics location provides resources for the K-12 teacher.

Budget of the U.S. Government, Fiscal Year 1998

http://www.access.gpo.gov/su_docs/budget/index.html

Budget publications and reports are available online from this U.S. Government Printing Office site. Users can search budget documents and download sections for further study.

U.S. National Debt Clock

http://www.brillig.com/debt_clock

The clock continuously updates the amount of the national debt. Using figures from the U.S. Treasury Department and the Census Bureau, the population is figured along with the debt, showing each citizen's share of the debt.

VIII. Science, Technology, and Society

Addresses available on the web allow students to evaluate new technologies to determine the benefits to society.

National Museum of American History

http://www.si-edu/nmah/youmus/hohr.htm

The Hands-On History Room provides examples of new technologies throughout our nation's history.

IX. Global Connections

The World Wide Web provides innumerable locations for students to explore the realities of our global interdependence. International issues about a variety of topics including the environment, human rights, and economic competition can be explored through the Web.

International Environmental Agreements On-line

http://sedac.ciesin.org/pidb/pidb-home.html

This environment location includes an on-line tool for browsing and searching of text, summaries, and the status of treaties and other international agreements related to the global environmental change and sustainable development.

United Nations

http://www.un.org/

Collect information about the United Nations through audio, visual, and webcast. This address is divided into International Law, Human Rights, Economic and Social Development, Peace and Security, and Humanitarian Affairs.

X. Civic Ideals and Practices

Civic participation of individuals and groups can be monitored by exploring web addresses. Active civic participation can be developed using models found at other locations.

Give Water a Hand

http://www.uwex.edu/erc/

This location describe a watershed education program designed to involve students in local environmental service projects. With the information included, classes plan and complete a community service project to protect and improve local water resources.

Washington Post

http://www.washingtonpost.com

Students can access updated weather reports to examine the weather at a variety of locations. In addition students evaluate the latest national and world news. Stock quotes, other financial and business topics can also be accessed.

Yahoo News Summary

http://beta.yahoo.com/headlines/current/news/summary.html

Students can read the top news story of the day by contacting this location. Yahoo News Summary includes ten news headlines and a paragraph about each.

If we are to meet the current challenges in education, we must provide preservice teachers with the skills and opportunities provided through technology. As preservice teachers create effective units using the Internet, they begin to take advantage of the possibilities its resources provide. It is therefore essential upon all educators to modify traditional social studies curriculum to reflect the increasing use of technology with the exploration of the Internet.

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The Time Machine: Technology for Meaning in Social Studies

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These days, the collective memory of teachers often does not encompass the World War II era. Consequently social, political, and historical contexts have become more and more remote for their students. This lack of reference has led to difficulties presenting certain aspects of social studies to children. World War II, for example, has become so abstract as to be almost unreal to present day students. This paper describes a design for using the World Wide Web as a tool for enhancing social studies instruction. The purpose of the project was to increase student awareness of some of the social, historical and ethical issues surrounding World War II. The specific goal was to help students explore three key aspects of the War in Europe: occupation, resistance, and sacrifice. An additional criterion was that the basic concept of the design would be applicable to other subjects and other grade levels.

The unit focused on German occupation of Denmark during World War II. Instruction centered on the novel *Number The Stars*, by Lois Lowry. The book describes the adventures of a Danish girl, her family, and their Jewish friends in occupied Denmark. The instruction addressed the need to build prior knowledge of some of the issues arising from the German occupation of Denmark, so that students were aware of the social and historical underpinnings of the novel. It also addressed the need to relate the themes of occupation, resistance, and sacrifice to other periods in history and to other social contexts.

Empathy in Social Studies

Empathy involves the ability to identify emotionally or intellectually with another person. Fostering empathy has gained some prominence in social studies during the last decade (Farmer & Knight, 1995). Ideally, creating empathy with people from the past can help students better understand the choices that people throughout history have made by helping them identify and understand the emotional, intellectual, ideological, and contextual factors that were involved in those choices.

Farmer & Knight (1995) maintain that:

> [The] connection between learners' general thinking and their understanding of history can be seen when we examine the place of 'empathy' in school history. Learners apply their knowledge about people in the present to account for the actions of people in the past and use similar scripts to explain the actions of people in the past and life in the present. (p. 26)

It is therefore critical to help students to make connections between their contemporary lives and those of people who lived in the past, thereby giving them a basis on which to build understanding of situations that would otherwise lie outside their frames of reference, and therefore be foreign and uninteresting.

Brown (1995) and Ashby & Lee (1987) describe a seven step process through which students gain historical understanding. Empathy is an integral part of the process they explain, and consists of several levels with corresponding actions, knowledge, and assumptions needed to understand the past:

1. A *baffling past*, in which students may be interested, but are unable to explain.
2. A *'divi' past*, in which students view people in the past as morally and intellectually inferior, and thus uninteresting.
3. An *ignorant past*, in which people in the past are seen as inferior because of what they do not yet know.
4. *Generalized stereotypes*, where people in the past and their actions can be understood by an assumption that their lives were very similar to those of people today.
5. *Everyday empathy*, in which students see a point in empathizing, but still assume that people's lives in the past were like those of people today.
6. *Restricted historical empathy*, where understanding of people in the past must come from examination of their specific situations.
7. *Contextual historical empathy*, in which students base their understanding on beliefs, ideas, values, and contextual situations from the past and today.

Ashby and Lee (1987) describe empathy as an "achievement", a place "we get to when we have successfully reconstructed other peoples' beliefs, values, goals, and attendant feelings" (p. 63); a place in which one can grasp entire structures of someone else's ideas, even those with which one disagrees, and take someone else's point of view.

Similarly, Portal (1987) discusses "projective imagination". Projective imagination allows students to bring their own intuitive way of observing and making judgments to the learning environment, allowing them to examine a new situation by applying their accustomed techniques for gathering and analyzing contextual data. He warns that this will not necessarily provide insight into the "authentic thoughts of the past," but it will allow the student to form hypotheses that will help explain peoples' behavior in other contexts.

Fostering empathy in social studies is thus a process by which students base their understanding of past people and events on present day experience, and achieve a state of mind in which they can consider the beliefs, ideas, and actions of other people. In order to build empathy successfully, students must eventually develop the ability to consider past and present contexts and values simultaneously in order to make informed, valid comparisons, and thus gain a better insight into the patterns of human behavior throughout history.

Prior Knowledge

The level of a student's ability to empathize with others in different historical, geographic, or social contexts is an aspect of the prior knowledge that all students bring to their education. This aspect of prior knowledge, to be sure, is underdeveloped in some and more developed in others. Although it may be tied to or limited by a student's psychosocial level of development or life experience, it can be enhanced.

Prior knowledge can be described as a combination of the learner's preexisting attitudes, experiences, and knowledge (NCREL, 1995). There is some debate about prior knowledge and its use in instruction. Seen from a constructivist point of view, some of the failings of computer-aided instruction may be blamed on inappropriate instructional design that does not properly take into account students' prior knowledge. These failings can be laid at the feet of computer-aided instruction that is produced according to a transmission-absorption, or behaviorists model (Kennedy, 1995). It is a durable model of education: prescriptive, controlling, and often unfeeling.

Other aspects of the debate about the role of prior knowledge in instruction center on the presence of a reified prior knowledge (Roschelle, 1995) rather than on building or enhancing the dynamic knowledge base or context in which to present new instruction. Roschelle frames the debate succinctly:

> On one hand, educators rally to the slogan of constructivism: "create experiences that engage students in actively making sense of concepts for themselves." On the other hand, research tends to characterize prior knowledge as conflicting with the learning process, and thus tries to suppress, eradicate, or overcome its influence (1995).

While this debate may be a valuable academic exercise, onlookers might not sense from this argument that prior knowledge is something supple and changeable. The debate centers on what might be called weed control. What one side sees as undesirable, another might see as valuable or even necessary.

In constructivist learning different types and degrees of interaction are critical: "[c]onstructivism asserts that the world is not found, but made through interaction with experience. The learner acts as a theorist who continually refines his own structure of knowledge based on experience (Connell & Franklin, 1994, p. 610). Seen thus, prior experience is a crucial tool with which the student shapes instruction.

Resnick (1987) speaks to "a general need to redirect the focus of schooling to encompass more of the features of successful out-of-school functioning" (p. 19):

> Evidence is beginning to accumulate that traditional schooling's focus on individual, isolated activity, on symbols correctly manipulated but divorced from experience and on decontextualized skills may be partly responsible for the school's difficulty in promoting its own in-school learning goals (p. 18).

In the "learning communities" of Jonassen (1995): "knowledge construction is not supported by technologies used as conveyors that prescribe and control all learner interactions." (p. 61)

Social Studies and the Web

The persistence of the behaviorist model also accounts for the types of World Wide Web sites that purport to be educational, but in fact only supply a lesson plan or a syllabus. There is no compelling educational reason for such material to exist in this context except convenience for the site administrator. These sites say, "Here's the material. Come and get it!" The site owners cynically reduce the educational transaction to a one-way street: "You pay. I give. I don't care if you learn anything."

These prescriptive WWW sites are functionally different from constructive sites. Prescriptive sites, both commercial and nonprofit, seek to present curricula, objectives, or other educational packages. They contain files that are designed and delivered as instructional tools. That is, they use the World Wide Web as a medium for the delivery of instruction itself, or to deliver prepackaged instructional material.

Constructive Internet sites leave it up to the learner how to understand and use educational materials. Constructive sites can be interactive sites where electronic tutoring takes place. For example, Calculus and Mathematica Distance Education programs (targeted at "nontraditional students working in homes") can be offered over the Internet, with a sequence of electronic "notebooks." Other examples include virtual field trips, like guided tours of colonial sites such as Williamsburg or Jamestown, online museums, and hyperworlds. Further examples of constructive sites include projects or "unit studies" like the Jason project in which students "take part in global explorations using advanced interactive telecommunications."

Discussing the need for designers of educational interactive web sites to have empathy for their target audience's prior knowledge, Roschelle (1995) and others have remarked that the burden is on the designer to cultivate a habit of attention to the needs of its intended audience, to, in effect, empathize in order to build empathy. Based on the way prior knowledge shapes learning, instructional designers must be sensitive to the different knowledge bases of their intended audience. They must listen and watch, and be attentive to the learners as they use the materials.

The project outlined here began as an attempt to build a prior knowledge base for sixth grade students who were about to begin a unit of study on World War II. More specifically, the instruction was designed to help the students investigate the concepts of occupation, resistance, and sacrifice that are central to the plot of *Number The Stars*. Our needs analysis showed that students were lacking an empathetic understanding of what life was like for people who had endured hardships in the past. In order to build understanding and empathy with the impact of foreign occupation, the danger of resisting the occupying forces, and the sacrifices made by those who lived in these conditions, students were given an opportunity to experience their lives in a similar context.

We wanted not only to build an interactive site that would fill this particular need. We also wanted to be able to apply our basic design to a range of educational contexts. Accordingly, we designed an interactive World Wide Web site (http://poe.acc.virginia.edu/~pm6f/Day1.html) where students could begin to understand the three themes on a personal level prior to reading *Number The Stars*. We provided a web form in which the student entered details of his or her own life, including name, age, favorite food, the name of a friend or classmate, and the name of a neighbor. These details were then inserted, via a perl script, into a story that was designed to exemplify one of the three key concepts of occupation, resistance and sacrifice, during the era of the Underground Railroad or World War II Denmark. We chose the era of the Underground Railroad as an historical context because it is a time during which the themes of occupation, resistance, and sacrifice are woven into the retelling. The Underground Railroad, by virtue of being studied before World War II, also provided the material for the subtext (or deep learning) of applying basic historical themes to other social, political and geographic contexts. Even though they had studied it in the recent past, giving the students the tools for making this historical era accessible was a necessary first step.

By inserting details of their personal lives into the two social and historical contexts, the students developed a frame of reference for a more intimate understanding of what occupation, resistance and sacrifice meant. They directly connected the details of their lives to those of people in the past.

The activity was broken into two days. The first day covered the Underground Railroad, and gave the students the choice of three scenarios in which to place themselves: A runaway slave, a child of a conductor on the Underground Railroad, or a child of a southern planter. The second day of instruction covered World War II, and, similarly, provided three scenarios: A Jewish child in Copenhagen, a Danish child, or a Danish farmer's child. The students placed the details of their own lives into the stories, and, in effect, became the characters in the stories. The resulting stories were printed out each day, and read to the class by the student who had supplied the personalized details. Each student's story was then discussed, allowing the students to more fully explore their lives in these new contexts, and also allowing the class to understand how someone they see everyday experienced occupation, resistance, and sacrifice. The web site remains available for students to "try on" the lives of these ordinary people in other places and times.

Remarks

In order for students in social studies to connect with the past, they must be able to see other peoples' struggles and triumphs as if they were being played out according to discernible patterns of human behavior. These patterns can best be uncovered by placing the students themselves in the picture. The great themes of world history will only be revealed to those who are able to see themselves as the people of the past saw themselves. Only by building empathy in the study of society can modern-day students construct a frame of reference in which historical figures are not images flashing across a screen or words in the pages of a book. Only by enhancing their prior knowledge of their own humanity can students add the depth of understanding in which history resonates, and the face of our shared humanity shines.

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SPECIAL NEEDS

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Once upon a time, not so many years ago as stories go, there lived a beautiful young woman, with her mean step mother and two ugly stepsisters. This beautiful young woman, let's call her Cindy, worked very hard doing all the housework, making the meals, running the car pool, managing the 401-K plan, and studying law during the day. At night, she ran a fabulous gourmet restaurant which served mainly vegetarian meals with an occasional retreat into New Californian cuisine. How did Cindy find the time to do ALL of this, you might ask? You'll just have to wait! One day, Cindy and her stepmother and stepsisters heard that the Prince, who we shall call Fred (as that was his name), was going to have a giant party in order to find a bride so that he might be married. Well, as you can imagine, the stepmother was overjoyed, as she had long given up hope that her two daughters were ever to be married. Everyone was so excited, including Cindy, who had high hopes of getting to cater the party. Well, time passed, as it has a right to do, and Cindy had not heard from the cateringeoff at the palace, so she just basically just forgot about that job. Besides, she had other things to do. The night of the ptrty, stepmother and her daughters left several hours early in order to get a good seat in the palace to talk about the people as the came to the party. Cindy was not too happy to be left at home, but she decided that she would stay home and try out a new recipe for Caramel Flan that she had found in an old cookbook. As she lit the fire under her double boiler, WHOOSH, what should appear but the Wicked Witch of the East. "Can I help you?", Cindy asked, since she was both beautiful and polite and had learned never to be shocked when she made flan. "I can help you go to the party at the palace if you like" said the Witch. Cindy thought a minute and replied, "No thanks, I've just got too much to do anyway." So with that, the Wicked Witch bought some day-old gingerbread from Cindy (since she was expecting some children to drop by later that night) and popped off . "Now to get back to work", thought Cindy. And so she did. Turning to her desk, Cindy began work on her latest novel, "Midnight In the Driveway of Good and Evil." And so the candlelight fades slowly on our dear Cindy and her story. But wait. How did Cindy do accomplish this? Well, since this is only a fairy tale, she actually had to do it all the old-fashioned ynay plain old hard work. They didn't even have electricity back then, much less technology. Do you think she WANTED to have to do her 401-k with charcoal and a shovel? I should think not. She would have loved to have had a computer. But she didn't. And we do. And that's the moral of the story.

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Assistive Technology: Preservice Training for Special Educators

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Recently, the need for training special educators to work with students who use assistive technology has become recognized as a national priority (Behrmann, 1995, 1993; Behrmann, Morrissette & McCallen, 1992; Flippo, Inge, & Barcus, 1995). However, much of this attention has focused on inservice programs for special educators and rehabilitation personnel; while little attention has been devoted to training preservice special educators (Bowser & Reed, 1995). Yet the Council for Exceptional Children, the largest professional organization for special educators, has included technology training as one of its many preservice competencies (CEC, 1996, 1994, 1990). Therefore, in response to preparing better preservice special educators, Towson University initiated a course design process in the fall of 1996. A faculty development and research grant was secured to purchase equipment and design the special education course called Assistive Technology for Students with Disabilities K-12. This course was subsequently approved by the university curriculum committee in fall 1997 and is slated to be offered in spring 1998. The purpose of this paper is to present a follow-up report on the initiative begun Towson University to design and implement a preservice course for special educators in the use of assistive technology. The first phase of this effort was presented at the 8th annual conference for the Society for Information Technology and Teacher Education (SITE).

Project Goals and Objectives

The current project is an important component in the design of an undergraduate major in special education at Towson University; however, the course Assistive Technology for Students with Disabilities K - 12 is an elective course. This course also represents a collaboration between faculty in the areas of special education and instructional technology and the Baltimore County Public Schools. This collaboration brings together expertise across disciplines and strengthens the relationship between the teacher education program at the university and the surrounding schools. It is hoped that this collaboration will eventually lead to an inservice course for educators of students who use assistive technologies and possible expansion of special education technology at Towson University. Future goals and objectives include a Masters Degree in Special Education and Assistive Technology for Students with Disabilities K - 12 will be a required course in this degree program.

Methods and Activities

During the spring of 1997, a special education faculty member applied for and received a summer stipend from the university faculty development and research grant committee totally $4600. The purpose of the summer stipend was to purchase equipment for and design the course Assistive Technology for Students with Disabilities K - 12. A total of $2500 was spent for equipment and the remaining $2100 was a salary stipend for designing the course. A list of the budget request, type of equipment purchased, cost, and vendors can be found in List 1. The following summer, a series of 10 lessons were created using the presentation software package Powerpoint and equipment was purchased. A list of the lessons designed can be found in List 2.

Successful Inclusion

With regard to the course design process. The special education faculty member submitted the proposed course for approval to the Department of Reading, Special Education, & Instructional Technology. After departmental approval, the proposed course was submitted to the College of Education Curriculum Committee where it was approved and then sent to the university curriculum committee in the fall of 1997 where it was also approved and is now scheduled to be offered spring 1998.

To ensure student enrollment in the course, the special education faculty member was awarded 3 hours of assigned time for fall semester 1997. During this assigned time, the faculty member presented an overview lesson of assistive technology to 11 sections of undergraduate students enrolled in Introduction to Special Education and 1 graduate section of Mainstreaming for the Classroom Teacher.

Students in the classes were given a series of handouts generated from the overview lessons and a description of the proposed course. The potential audience was approximately 300 students. In addition, a flyer announcing the course offering was also created and distributed to students as well as teachers in the surrounding local education agencies (LEAs).

List 1

Item	Vendor	Purchase #	Cost
Minitalking Card Reader	Crestwood Company	1140	69.95
Franklin Speaking Ace	Jane Hagger & Associates	ACE-200	69.00
Mac ACCESS Pac 1	Intellitools	MAP1-197	650.00
Math Pad (5pac)	Intellitools	CM-MPM-197	299.00
Keyguard for Standard Overlays	Intellitools		
Bid Red (Switch)	Intellitools	AN-BR 197	42.00
Jelly Bean (Switch)	Intellitools	AN-JBC 197	42.00
Touch Window	Laureate Learning	841204	335.00
Macintosh Switch Interface	Don Johnston	M09	135.00
Write Outloud (5 pac)	Don Johnston	J30LP	346.00
Co-Writer	Don Johnston	M30	290.00
Alpha Smart Pro	Intelligent Peripheral Devices		279.00

List 2

Overview of Assistive Technology
Characteristics of Students with Disabilities
Legal Perspectives of Assistive Technology
Input & Output Devices

Written Expression & Assistive Technology
Hardware & Software Evaluation for Use with Students with Disabilities
Lesson Plans on the WWW & the Integration of Assistive Technology
Emerging Literacy & Assistive Technology
Intellipics

Outcomes and Impact

There will be several important outcomes of this project. First, the course will be offered in spring 1998 with an initial enrollment of 25 students. Second, if the course is successful based upon student evaluations, the potential exists to offer more sections of the class in the future. Third, there is the potential to offer the course to inservice teachers through a cooperative, outreach program with Baltimore County Public Schools. Finally, with the continued emphasis placed on technology and the direction of the strategic plan of Towson University, there may be the potential to design a minor or concentration in special education technology to compliment the Bachelor of Science major recently awarded to Towson University. Future plans also include the inclusion of this course as a requirement for the Masters of Special Education degree.

Timeline and Completion Dates

Data analysis will be completed in spring of 1998 through student course evaluations Based upon that analysis and faculty availability, subsequent offerings of the course will be determined. Based upon satisfactory student evaluations, a discussion with Baltimore County Public Schools will be initiated to offer the course in the future to their teachers at Towson University. Furthermore, in the spring of 1998, the special education faculty member will submit another faculty development grant to purchase additional equipment for the course.

Evaluation Plans

Quantitative and qualitative data will be collected via student evaluations of the course Assistive Technology for Students with Disabilities K-12. The preliminary course will be evaluated by the Facilitator of Assistive Technology for Baltimore County Public Schools also and comments from that office will be considered in the modification of the course.

Current dissemination plans include sharing of the course design process and course contents with the surrounding school systems of Baltimore City, Anne Arundel County, Howard County, Harford County, and others as appropriate. In addition, local, regional, and national presentations are planned for Maryland Association of Educational Uses of Computers (MAEUC), the Maryland Instructional Computer Coordinators Association (MICCA), the Maryland Association of Teacher Educators (MATE), the Eastern Educational Research Association (EERA), and of course Society for Information Technology and Teacher Education (SITE).

Summary

In summary, this presentation will provide participants with (a) an overview and timeline of the course design and implementation process (b) an outline of the course syllabus, (c) preliminary data from evaluations of an overview lesson for assistive technology, (d) outcomes and impact of the project, (e) timeline and completion dates for future course development and (f) evaluation and dissemination plans for the project.

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SpEdExchange: A Cyberspace Link for Preservice Special Education Teachers

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Future educators participated in an online discussion of issues related to teaching students with disabilities. The 98 students subscribed to the SpEdExchange listserve and were enrolled in teacher preparation programs in Minnesota, Missouri, and Indiana. Messages were saved electronically and analyzed by topic. The participants were also given pre- and post-surveys to gain information on their computer usage, perceived level of internet skills, and the benefits and difficulties communicating via the listserve.

A process was established to ensure that participants began and ended their listserve experience at the same time. Academic calendar years varied and one institution was on the quarter system so data collection began when all participating universities were active. Message collection for the project ceased when the grading period ended for the first institution.

Message Analysis

The analysis of posted messages was completed by two preservice teachers and repeated by a post-service teacher and a professional outside the field of education to assure consistency in interpretation. All messages were saved electronically and hard copies were printed for future analysis. Duplicate and incomplete messages, and requests to subscribe or unsubscribe were excluded from content analysis. The 458 remaining messages were categorized according to major theme. Ten major themes were identified along with a miscellaneous category for messages that were not related to any other message. The messages in major theme areas were then further categorized according to topical area. Descriptive statistics were used to determine frequency of responses in each area and categories were ranked in order of most to least frequency of responses.

In the first category, Placement and Setting, messages dealt with the importance of student interaction in the classroom, preference for teaching students with special needs in a regular classroom or resource room, and identification of students with special needs due to a "label" or "different" treatment. Participants were especially concerned about the quality of interaction between peers and students with disabilities in regular settings and how the teacher modeled or promoted acceptance.

Table 1.
Themes With Frequency and Percent of Total Postings

Themes	Frequency	Percent
1. Placement and Setting	80	17.40
2. Educational Interventions	76	16.40
3. Philosophical Issues/Personal Reflections	64	13.90
4. Classroom/Administrative Interventions	44	9.60
5. Miscellaneous	40	8.70
6. Extracurricular Activities	39	8.50
7. Non-Educational Interventions	38	8.20
8. Educating Teachers	35	7.60
9. Use of Technology	26	5.60
10. Resources	12	2.60
11. Syndromes/Disorders	4	.08

Messages with the topic of Educational Interventions included discussion of reading interventions, behavior management issues, and grouping students for optimal learning. Participants expressed anxiety related to managing difficult behavior and exchanged strategies for teaching reading and math.

Most postings relating to Philosophical Issues/Personal Reflections concerned reactions to poems, quotes, stories and humorous anecdotes. Several poems were posted which stimulated discussion and appeared to help participants develop empathy for students with disabilities.

In the fourth most discussed category, Classroom/ Administrative Issues, messages addressed advantages and disadvantages of team teaching, use of personnel and optimal class size to provide individual instruction, and viewpoints regarding the class within a class model of

collaborative teaching. The importance and barriers to working collaboratively were also discussed.

Pre- and Post-Survey Analysis

Pre- and post-surveys were given to the preservice educators at each university. These surveys asked questions regarding computer usage and internet skills. The surveys also included questions about the benefits and difficulties encountered when participating in the listserve. From the pre-survey, the researchers found that less than 25% of the participants had prior experience with listserves. In the area of computer usage, the participants reported significant increases in using word processing, sending e-mail, and accessing the World Wide Web. They also reported significant increases ($p<0.0001$) in internet skills as a result of participating in the listserve.

The responses dealing with posting on the listserve revealed three results: (a) When asked to describe participation in the listserve the mean was in the *infrequent poster* range. (b) Participation was significantly easier than the students predicted. (c) Though beneficial, participation was significantly not as beneficial as the students had predicted in the pre-survey.

Most comments made on the post-survey were very positive about participating on the listserve. Students seemed to enjoy sharing information and viewpoints and several attributed the listserve to expanding their view of Special Education. Some of the comments were the following: "Information, a variety of opinions, ideas, new things to think about, professional conversations, a variety of perspectives." "Seeing others thoughts and concerns at being a Special Educator. You know that others are going through the same things." "It helped me with strategies and basic questions I had." It allowed me to address questions I had." "I enjoyed learning other opinions on certain controversial issues in the education field." "I enjoyed seeing the many different opinions that were viewed on the listserve. It was interesting seeing alternative solutions to the different situations." and "I learned a lot from the other students. I have learned about material that I did not know about and I have changed some of my viewpoints towards inclusion. I also had a chance to hear other viewpoints about Special Education."

Recommendations

Several recommendations were drawn from the results of the analysis of messages and the participants' responses. They included the following:

1. Messages tended to reflect a concern for the actual placement and equitable treatment of children with disabilities. Teacher education should continue to focus upon the impact of a disability upon an individual. It should also address the needs of the classroom teacher for strategies that will minimize this impact and maximize learning.
2. Messages often noted inventive strategies for academic learning and sought more strategies and materials which could be useful. Teacher preparation programs may benefit from direct provision of sources for materials and strategies. It may also benefit from allowing preservice teachers the opportunity to try the materials in hands-on situations.
3. The participants expressed the desire to practice more collaborative skills in regular settings. A training partnership between special and regular education programs may be beneficial in meeting this perceived need.
4. Many messages noted apprehension in the ability to deal with motivation and conduct issues. Confusion regarding implications of laws and policies was apparent. Preserviceteacher education may benefit from the greater exposure to policies and practices in behavior management.
5. Participants reported significant increased use of computers and increased levels of internet skills. Posting messages on the listserve seemed to increase the use of word processing, the World Wide Web, and e-mail. Teacher educators must keep in mind that integrating technology into coursework may or may not enhance the quality of instruction.
6. Participating in the listserve was perceived as beneficial by the preservice teachers but not as beneficial as had been originally predicted. The benefits listed by the participants in the post- survey fell primarily into two categories of sharing information and expressing opinions. Future educators appear to have a desire for all the information they can gather that includes resources, strategies, and materials. They were eager to express their opinions about issues in the field of Special Education and developed professionally by exposure to differing viewpoints.

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Networking Special Education Teachers: Providing Distributed Resources on Special Needs

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Special Education teachers in primary and secondary school face daily challenges when working with special needs students. Teacher training and resources on special needs are usually scarce, and when available, are sometimes difficult or timely to acquire. Moreover, since the special education arena is very diverse, it is rare for a special education unit within a school, or even within the local area, to have the expertise and solutions for all issues. By forming world-wide networks between special education teachers at 1) the physical infrastructure level, 2) the information level and 3) the communication level, a special education community can be created with minimal distance, cost, societal and access barriers.

Computer-Network Infrastructure

When creating a distance education resource for special education the first thing required is a physical network infrastructure that links special education teachers and classrooms. The NII (National Information Infrastructure) initiative in the US, and similar government initiatives in Canada and other countries, ensure that a growing number of Internet-ready computers will be in the classrooms by the turn of the century (Brummel, 1994). A computer in every classroom is becoming a reality, and a computer for every student is becoming a new aim for some organizations. Because web browser software is ubiquitous, free for educational institutions, non-proprietary, and fairly accessible to those with disabilities, it is the ideal interface to a special education infrastructure. With the current availability of browsers and computers, and the low cost of Internet access, a web-based network is the most cost-effective, flexible and dynamic choice of network.

The student population that special education teachers serve has unique needs and equipment requirements for computer access. The computer interfaces to resources and learning materials should be accessible and adapted to accommodate students with special needs (Nguyen & Petty, 1997). Assistive computer devices such as screen readers for students with visual impairments, or alternative keyboards and mouse devices for students with motor impairments, are a necessary part of any web-based special education network infrastructure

Specialized infrastructures may augment and complement a web-based network to achieve particular goals in delivering special education resources. For example, 56k / 64k ISDN videoconferencing can be used to bring experts and consultants from urban centers into more remote and resource-poor, rural schools for real-time consultation on specific issues. 336k / 384k ISDN video conferencing can be used to bridge together American Sign Language (ASL) communities, where high-speed bandwidth is needed to maintain the video fidelity and frame-rate required for the nuances of sign language. The drawback of specialized networks is the increased cost, and the limited number of compatible sites one can communicate with. However, until consumer-level Internet access evolves to a more advanced state, specialized videoconferencing networks can serve certain purposes that web-based networks cannot.

The creation of an adapted physical computer networks is the first step before special education teachers and students can access distributed information or interact through on-line communities.

Information Networks

Web-based information networks should be designed to allow special education teacher to share resources with one another. Disparate resources, examples of best practices, lesson plans, teaching methodologies and digital libraries can be pooled together into a definitive clearinghouse on special education and related topics. Ideally, this clearinghouse of information would be easily updated, dynamically managed and disseminated to an unlimited number of teachers. Because the information is in electronic form, it is inherently more accessible for persons with disabilities than printed information; as the information can be enlarged, read though a speech synthesizer, or navigated without a page-turner, via assistive computer devices. Accessible HTML should be incorporated into the web pages to ensure that the information is usable by the broadest possible audience (Letourneau, 1996).

Not all information disseminated through web-based networks is text. Innovative web technologies can be exploited to deliver multi-modal information and resources.

Educational videos, or audio recordings from libraries for the blind, can be shared through an Internet based network. Such materials enhance the appeal to learning by being more dynamic and lively. Enticing and enriching materials will make a learner want to learn. Where possible, multimedia materials should also be adapted to meet the needs of special education teachers and their students. Videos can be captioned for those with hearing impairments and descriptive audio can be added for people who are blind. Text transcripts of all audio/video should also be provided to allow for easier review and navigation of the materials for persons with print impairments or learning disabilities.

Any information should be available at all times and easily located. Ideally, teachers should have the ability to submit new information entries to a resource clearinghouse that would go though a review committee to ensure appropriateness. As a resource collection grew, standardized processes for cataloging, organizing, and searching through the information would become necessary.

Interpersonal Communication Networks

There are several methods in which special education teachers can use network-based systems to communicate with one another. Listserves and web-based discussion forums bring together people with common interests to discuss specific topics. Synchronous forms of real-time communication are possible through web-based chat systems or 3D-mediated environments. Any of these on-line systems can be set up with restricted, secured access for scenarios such as mentoring, consultations, or testing and certification.

Interactive courses for professional development in the area of special education can be easily authored for the web using courseware development packages. These courses can provide opportunity equity for those that are geographically challenged (Paulet, 1989) or for those who wish to take highly specialized interest courses that aren't offered locally. Web courses can also act as a catalyst for on-line relationship building between teachers who share similar interests. These can become starting points for an on-line communities built around SIGs (special interest groups).

An electronic classroom is a classroom without walls where cultural and societal barriers are eliminated. A person has the choice to reveal as much or as little about themselves as they want, allowing a new on-line persona to be constructed that can facilitate communication and learning (Gold, 1997). For example, a hearing-impaired student (or teacher) who is quiet around peers may be more participatory during on-line conversations. Also a student can choose to hide or disclose his or her race, sex, age or disability. The anonymity that on-line communication networks provide can help eliminate pre-conceptions or prejudices that people sometimes hold against others who have visible differences. A more level playing field is introduced for a greater integration of a diverse population.

Web-based communication can also allow continued networking with colleagues beyond conference and special interest meetings. The building of professional contacts, links to experts in the field of special education, and the sharing of knowledge can all facilitate teachers in finding solutions to special needs issues.

SNOW - Special Needs Opportunity Window

Special Needs Opportunity Window (SNOW) is a pilot project funded by the Ontario Ministry of Education and Training. It is currently attempting to network together special education teachers throughout Ontario, and from around the world, utilizing the ideas and methods listed above. The SNOW project can be explored at *http://snow.utoronto.ca* . There are several other projects in development at the Adaptive Technology Resource Centre that are also looking at ways to network special education teachers and students. These will eventually be linked through the SNOW web site as well. It is hoped that by bringing important issues of education access, community and technology to the foreground, other web-based special education programs can benefit.

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1009

TECHNOLOGY DIFFUSION

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Papers in this section reflect the diverse ways that school districts, teacher education faculty, private consultants and school administrators are trying to help teachers better use technology in their classrooms. Collaboration seems to be the keyword. Schools, universities, government agencies and members of the private sector are teaming up to address the ongoing problem of providing professional development and support for teachers to integrate the use of technology with their instruction.

The first paper is a progress report of the implementation of a Technology Innovation Challenge Grant awarded in 1995. Marx describes the progress made over the first two years and outlines an Instructional Technology Master's degree program offered through the University of Texas at El Paso. The IT program was designed to help teachers in the 5 district consortium that received the grant: ". . . develop classroom teachers who are technologically literate, understand how to effectively and appropriately integrate technology into their lessons, are able to design and implement innovative technology-infused curricula, and act as change agents in their schools and districts."

Gershner and Snider also describe a school district/university partnership. In addition, one of the districts participating in their Community Collaborative Professional Development Center (CCPDC), Ysleta ISD, is also participating in the a Technology Innovation Challenge Grant project described by Marx. The CCPDC coordinates the preservice teacher-training efforts of Texas Women's University by linking teacher educators with schools in 7 local school districts to provide field placements for students and community business partners. The Center is supported by the Corporation for Public Broadcasting and has developed a Classroom Internet Integration Project that supports participating district's efforts to help their teachers develop technology skills, and the teacher training efforts of the university.

The Wunsch paper presents an overview of the evolution of the STAR project intended to provide integrated mathematics, science, and technology experiences for all secondary science and mathematics students in over sixty Houston Independent School District schools. She described how the project changed and developed over time and indicates the role of project participants including the University of Houston, Rice University, the Houston Museum of Natural Science, NASA, and Space Center Houston. The National Science Foundation provided funding for this project.

Nunn, McPherson, and Rust describe a partnership between Johns Hopkins University and the Baltimore Public Schools designed to train teachers to become school-based leaders in technology through a 36-credit graduate program in Technology for Educators. They outline the Master's program they designed and highlight the challenges associated with developing the program and challenges they faced in making it work. Breithaupt also describes a collaboration between a university and school district. He describes a project in which student teachers were paired with inservice teachers to work together to integrate technology with their instruction. Student teachers are a valuable resource for inservice teachers because they brought pedagogical innovation and technological expertise to the relationship.

Canipe and Parrish describe a federally funded project to provide training for teachers in five school districts. They present the underlying philosophy that guided their instructional focus and the relationship they are developing with LearnNC, housed at the University of North Carolina at Chapel Hill, to disseminate their materials on the Internet.

The Reesor paper is a bit of an anomaly in that it describes the efforts of a single school to integrate technology into the curriculum. As a small private catholic school, they lacked the resources and expertise available to the public school districts and universities described in the other papers in this section. Their efforts were supported by parent organizations, the local library, and Apple Canada; however, the development of the technology plan was

accomplished primarily through the work of teachers and administrators in the school.

The next two papers provide some general principles to help guide technology infusion efforts. Budin and Meier support a constructivist view of teacher development and encourage integrating technology skills training with relevant instructional activities, the use of integrated curricular projects, and providing a variety of instructional methods for training teachers. They focus on changing the culture of the school by individualizing change processes for specific schools and teachers and remind us to provide support over a sufficient period of time for change to occur. Barnes presents seven issues that should be addressed to increase the likelihood that technology integration efforts will succeed and sustain. He points out the need for administrative support, evaluation and accountability, and teacher access to computers to support meaningful curricular integration.

The final paper in this section addresses the key role of the technology coordinator in providing ongoing support and leadership for technology integration. The Marcovitz paper raises some interesting concepts about the work of technology coordinators through a mini-case study of one coordinator. The concept of "walk around support" is presented and it's effectiveness with many teachers is explored. The visibility and interactivity that occurs when the coordinator walks around the school to complete various tasks promotes a high level of communication and technical support with the faculty. This allows the technology coordinator to serve in a policy making role because of his or her thorough understanding of technology needs in the school.

These papers provide some interesting insights into collaborative projects for enabling teachers to use technology with their students. The current trend toward school/university partnerships that draw on a variety of community resources provides a multi-level approach that may promote greater success for technology infusion projects.

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El Paso's OERI Technology Innovation Challenge Grant: A Progress Report

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In the Fall of 1995 El Paso was awarded a five year Technology Innovation Challenge Grant for $3.4 million. The goal of the grant is to create a community of 21st century learners by working with the three major school districts in the area (Socorro, Ysleta, and El Paso Independent School Districts) and fourteen partner schools within those districts. Technology is seen as an enabling force that allows students, teachers, and parents to overcome obstacles to success that exist in thi low-income, low technology, primarily Hispanic region. The grant has five major components: connectivity, parent centers, e-mail mentors, professional development, and evaluation and sustainability. This section will examine each area of the grant in terms of its goals and the progress made so far. All elements of the grant are designed to work together to create learning communities in each school involving parents, educators, students, and other community members. Technology use is integrated in many ways but is never seen as an end in itself.

Connectivity

The connectivity portion of the grant is designed to aid the partner schools in providing Internet connectivity to their classrooms. Each school district is allocated $120,000 to be used in the partner schools as deemed appropriate by the district. This flexibility was necessary because different districts, and schools within districts, are in various stages of wiring.

Funding for this and other components was given first to the Socorro ISD, as the grant's fiscal agent and most technologically advanced of the three districts. The Ysleta ISD got funds this year, and the El Paso ISD will receive these and other funds over the next two years, as they have six partner schools each, rather than the four each in the other two districts.

Progress. Connectivity is on schedule. The partner schools in Socorro have Internet connectivity in all classrooms; teachers and students are being trained in its use, and various types of Internet activities are being integrated into instruction. Ysleta received funds for 1997, and the partner schools are all wired and await final district action.

Parent Centers

Another major element of the grant is parental involvement. To this end, each partner school is required to set aside a physical space for a parent center. The grant provides equipment for the parent centers (again one district per year) once this location has been set aside. Equipment includes: a multimedia station including Power Macintosh computer, printer, scanner, digital camera, video camera, large TV/monitor and cart; and 15 Powerbooks (Socorro ISD) or e-mates (Ysleta and El Paso ISDs) for parent check out and home use. The technology is an incentive to help get parents involved in the schools and provide them with valuable training, but it is not the primary reason for the parent centers.

The parent centers are designed to increase parent involvement in the schools. In addition to technology training and laptop/e-mate checkout, a variety of programs are offered on each campus. These programs include citizenship classes, GED training, family enrichment programs, parenting skills, and visits from social service agencies.

Progress. All but one of the thirteen partner schools have parent centers up and running. The functioning parent centers have received their multimedia stations, and those in Socorro and Ysleta have received their check-out equipment; El Paso parent centers will receive their e-mates over the next two years.

As mentioned above, a variety of programs are in place at each parent center. Each center also has at least one person on staff as a parent educator; in some cases this person is a volunteer, while others are paid. The programs in the Ysleta and Socorro parent centers are generally very active, with good attendance and a variety of projects under way. A Parent Educator Association is being formed to share resources and provide staff development for all parent educators in the El Paso area. This program is having its intended effect of increasing parent involvement in their children's education.

E-mail Mentors

The goal of the E-mail mentor program was to pair up students in the partner schools with business people in the El Paso area. This would give the children a role model and someone to provide encouragement and help. Due to difficulties encountered in finding enough business people to participate, University of Texas at El Paso (UTEP) undergraduate education majors were enrolled as mentors from a science methods course.

Progress. For a variety of reasons, this program has met with limited success and is being scaled back. While there was enthusiasm from some teachers and mentors involved in the program, difficulties included infrequent and inadequate mail from the students, lack of access, and lack of focus. Mentoring is ongoing with some of the original participants, but the program will not be expanded.

Professional Development

There are two main parts to the professional development program: professional development for K–12 teachers and professional development in technology for the UTEP teacher education faculty. The teacher development program educates cohorts of 15–20 teachers at a time in the integration of technology and standards into the curriculum. Teachers receive a Master's Degree as an Instructional Specialist with an emphasis in Educational Technology; for those who already have a master's degree or are pursuing a master's in another field, an endorsement program is available where only the technology classes are taken with the cohort. The development and progress of this program will be discussed in greater detail below.

To help guarantee the integration of technology throughout the teacher education program, funds were also allocated for professional development of teacher education faculty in technology. After three semesters of limited success, this program has been suspended while other methods of implementing this development are investigated.

Progress. To date, two cohorts totaling roughly 30 teachers have graduated from the program. Four other cohorts, totaling approximately 70 teachers, are in various stages of progress. Initial results indicate high levels of satisfaction with the program and some progress in implementing the training. Future plans include observation of participants' classrooms during and after their participation in the program and other forms of formative and summative evaluation.

The original plan for faculty development in technology was to give one faculty member per semester release from one class, paid by the grant, and that member would participate in a cohort's technology class. For a variety of reasons including scheduling and different technological abilities, this plan did not work out. While limited progress has been seen in these faculty members use of technology, it has not been at the levels expected. The release program is no longer being used and other methods of faculty development are being discussed including: voluntary technology workshops during the semester on various topics; one-on-one mentoring of faculty; a combination of training and stipend to be used to purchase hardware or software for use in the classroom; and access to technology–rich teaching classrooms for faculty who participate in training.

Evaluation & Sustainability

While in one sense two separate components, evaluation of the success of the various programs and their sustainability after the grant money runs out are also connected. Various methods of evaluation are being used to determine the success of the different elements and these evaluations are, in part, designed to give feedback on the sustainability of these programs.

Connectivity

The success of this component is judged by getting schools Internet connectivity. Issues of sustainability involve maintenance and upgrading of equipment, and are outside the purview of this grant. They are the responsibility of the schools and districts involved. Thus far, this component has been successful. The Socorro district and Ysleta districts are both on track. The El Paso district, without grant funds so far, is making progress in the wiring of its schools for Internet access, and grant funds should allow the completion of this process in the partner schools over the next two years.

Parent Centers

Success of the parent centers is being evaluated in several ways. Physical locations have been established for all but one center. Numbers of program participants and parent volunteer hours in the schools are further quantitative measures being collected. More qualitative evaluation includes how parents are getting involved and volunteering at the schools and in their children's education, and will be harder to measure. Sustainability is being ensured by the formation of the Parent Educator Association and school support for the centers and their staffing.

E-mail Mentors

This component has not achieved success, and no additional resources are being allocated to it at this time.

Professional Development

Evaluation of the teacher education component includes a Likert-type survey administered when students enter and leave the program. This survey addresses their knowledge, confidence, attitude, and use of technology. In addition, students make regular journal entries in the technology classes and will include observation of participant classrooms during and after the program.

Sustainability will be measured by whether the master's program continues after the grant runs out. Participants currently receive partial scholarships paid by the grant,

while the faculty are either wholly or partially paid through grant funds. To measure interest from the teacher perspective, a self-paying cohort will be formed next fall; sustainability from the faculty perspective will be partly determined from interest in this cohort, and partly from the financial situation of the college. Sustainability will also be measured by the success of the faculty development program in integrating technology into the undergraduate teacher education program.

The Instructional Technology Master's Program

The goal of the Instructional Technology (IT) program was to develop classroom teachers who are technologically literate, understand how to effectively and appropriately integrate technology into their lessons, are able to design and implement innovative technology-infused curricula, and act as change agents in their schools and districts. The coursework consisted of four technology classes, taught by staff hired by the grant, and four general education classes, taught by both grant staff and UTEP teacher education faculty. In addition, there were two practica, one in mentoring and one in classroom action research. This section examines the model IT program we created for inservice teachers, the development of the practica into core components to ensure technology diffusion, classroom action research by teachers, and lessons we have learned from the process.

The IT Program Model

One of our primary goals was to produce a model program that is aligned with the new NCATE-approved ISTE standards for teacher education programs. The program addresses the flexibility needed in an IT program due to the rapid changes that take place in the field of technology. The goal was to foster change in what and how teachers teach and students learn. These concepts were more important than learning about any specific technology. We divided the model into two halves because certain concepts, theories, and tools naturally come before others and build an important base for more advanced theories and instruction.

An important factor in the success of this program that does not appear in the model above is the role of the general education classes in supporting the technology classes. We have had mixed success in aligning the goals of these education classes with the goals of the grant. A schedule has been developed with most of the classes taught by members of the challenge grant staff. This seems to be an optimal solution. In classes taught by faculty not associated with the grant, the relationship between course content and program goals has depended on the faculty members. Clearly, teacher education faculty involved in an instruction technology program should be involved in the planning and implementation process as much as possible, and should be encouraged to adopt the goals of the program.

Table 1.
An Instructional Technology Program Model

Half of Program	Subjects	Sample Tools	Concepts
1st	Mac & PC literacy; productivity applications; presentation programs; telecommunications; basic authoring; basic hardware; basic networking	ClarisWorks; HyperStudio; HyperCard; HTML; Pagemill; Powerpoint Student–based learning; cooperative learning and group projects; appropriate use of technology	One computer classroom; integration of technology into the curriculum; methods of computer use.
2nd	Advanced applications; advanced multimedia authoring; group authoring projects; individual focus areas; more hardware; more networking	Dedicated graphics programs (2D & 3D); sound programs; digital video; advanced Web tools (Java, CGI, etc.); advanced authoring programs (SuperCard, Director, etc.); web and file server software	Brain–based learning; curriculum reform & design through use of technology; systemic change; mentoring: diffusing technology – based change throughout a school; classroom–based action research (measuring change)

The Practica

While initially both practica were designated for mentoring other teachers in technology integration, it became clear that this was unnecessary. In light of the growing emphasis in the program on evaluation and looking for classroom results, we decided to separate the practica into one for mentoring and one for classroom action research. We have developed formal models for both practica to ensure their consistency throughout the program and to facilitate their use by others.

Mentoring. One of the original program components, designed to ensure diffusion of technology integration throughout a school, was mentoring. Each teacher going through the IT program was required to formally mentor three other teachers. A model has been developed and is being tested whereby cohort teachers pick two or three other teachers in their school to mentor. Based on an initial needs assessment filled out by each mentee, formal Individual Education Plans (IEPs) are written up, a course of study is developed and carried out, and evaluation is done by both the mentor and the mentees. This evaluation should be formative and summative, and should focus on the impact of the training on classroom instruction and student learning.

Research. As a way of ensuring cohort teachers begin to implement innovative uses of technology in their curricula, and investigate for themselves what does and doesn't work, we decided to design a classroom action research practica. One of the general education courses is on research, so this is a logical extension of that coursework. It also provides another method of evaluation for the grant, to determine if what is taught in the cohort classes is effective in the K–12 classroom. The specifics of this program are still being developed and will be tested in the spring of 1998 with one cohort.

Lessons Learned

While we have created a program we think meets the rigorous standards approved by NCATE and believe we are training our teachers to be change agents in their classrooms and schools, our successes have not come without difficulties. We have learned some valuable lessons that may be useful to those currently developing or revising an instructional technology program. Many of these lessons involved the initial setup of the program and include the importance of a dedicated lab for graduate students with sufficient computers, software, access, and peripherals. These conditions were not in place at the start of the program, and when we moved to our new lab, a marked improvement in teaching, learning, and attitude was seen. While it may seem a small point, the ability to darken the room sufficiently for an LCD panel or to have a high quality projector for whole class presentations is vital.

Aside from the physical location and setup for the technology classes, staffing was also an important issue. Because of the short time between getting the grant and having to start the program, staffing was not finalized until three semesters into the program. This was further complicated by one of the technology instructors leaving suddenly after the second semester. Classes are generally team taught by two technology specialists and one curriculum specialist. It is essential that a curriculum specialist be involved in the technology classes. This person need not be a technology expert, it is sufficient that he or she be willing to learn the technology as necessary for instruction. The curriculum specialist has been key in keeping the focus of the technology classes on students and curriculum and on the appropriate uses of technology. The importance of having faculty in the general education classes versed in the goals of the program was discussed above, but is mentioned here to emphasize the need for an integrated program. An instructional technology program should focus on instruction rather than technology.

Finally, technology coursework should be based on the reality of participating teachers' classrooms. All assignments in the technology classes are intended to be translated to the classroom. These assignments include lesson and unit planning with technology, software reviews, telecommunications activities, and multimedia authoring. Increasingly, classroom testing is a component of project assignments, further ensuring that teachers are focusing on their classrooms when completing assignments.

Conclusions

The use of mentoring to help diffuse technology use throughout a school is important for providing university instruction to a wider audience. Classroom research connects directly to the goals of the grant in increasing the use of technology in alignment with national standards and curriculum reform. Our work in formalizing these components is designed to ensure the success of the grant and provide help for other such programs.

The creation of a model scope and sequence for the program is vital for the same two reasons. One of the goals of the teacher education component of the grant was to develop a model instructional technology program. The length of the grant allows for extensive research on what does, and does not, work. The key is the translation from university instruction to K–12 classrooms, and as we have just started graduating cohorts, our research in this area is just beginning. But a concrete, yet flexible model that is aligned with new national standards allows others to look at what we've done and adapt it to their needs. Delineating the goals of the program, and a sequence for carrying out the program, makes it easier to align other education courses with the technology classes so that the program functions as a whole, rather than as separate parts.

After roughly two and half years, we feel the grant is on track and on schedule. The connectivity, parent centers, and professional development programs are working together and creating a synergy among formerly disparate elements of the school communities. While some elements, most notably the e-mail business mentor program, have not been as successful as hoped, we have learned valuable lessons from all parts of the program. We are piloting models of parental involvement and professional development in technology that may be useful to others working in these areas. While we are at an early stage in terms of evaluation, we are piloting models for this as well. Overall, we feel we are fulfilling the goal of the OERI Technology Innovation Challenge Grants in creating innovative, collaborative programs to increase student success and community involvement, and using technology as a tool to help us reach those goals.

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Classroom Internet Integration: A Collaborative Adventure

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The Community Collaborative Professional Development Center (CCPDC) coordinates the preservice teacher-training efforts of Texas Women's University (TWU) by linking teacher educators with school districts which provide field placements for students and community business partners. The CCPDC includes eleven school districts that provide field training sites for hundreds of TWU preservice teachers including two urban districts (Dallas and Ft. Worth), three suburban districts (Denton, Keller, Lewisville), and five rural districts (Aubrey, Lake Dallas, Little Elm, Pilot Point, and Sanger). Each of these districts has unique characteristics and the CCPDC design provides preservice teachers with experiences in multiple settings during their teacher education programs.

In addition to the eleven school districts, the CCPDC includes Regional Education Service Center XI, the Texas Parent Teachers Association, Community in Schools, and the International Business Machines corporation. An Advisory Board with representatives from each of the partners establishes policies for collaborative projects. The CCPDC Director reports to the Advisory Board and to the Dean of the College of Education and Human Ecology at TWU. Eleven university professors serve as CCPDC University Liaisons to link the university with participating school districts. The CCPDC program was established in the fall of 1996 and replaces the existing TWU teacher education program in the fall of 1998. Funding was used to support district identified technology needs and technology instruction on the university campus.

Classroom Internet Integration Project Collaborative Partners

School Districts

The CCPDC has developed a collaborative project to integrate the use of the Internet into participating schools. The Classroom Internet Integration Project extends through K-12, and in all content areas, to address the needs of teachers in the Aubrey Independent School District (AISD). AISD enrolls 905 students on its three campuses. Thirty percent of the students are considered at-risk because of low SES. The teachers in this district all have computers on their desk and are quite computer literate.

This project includes an all-level effort for training and utilization of Internet in all classrooms in the district. This effort is timely and possible due (a) to the size of the Aubrey district, (b) its advanced status in technology, (c) its history of collaboration (d) its support of staff development to reach district goals, and (e) the support for technology provided by the AISD School Board. Current technology resources include a 4 to 1 ratio of computers to students, WAN facilities, Internet access in all classrooms, and links to TWU, the CCPDC, and the Corporation for Public Broadcasting (CPB).

Aubrey ISD is a rural district with limited local resources. However, they have community support for building a new high school and renovating other facilities and have state grant support for the installation of Internet in every classroom. Texas Woman's University completed the classroom connections for Internet access the fall of 1997 and provides training in educational technology through the Department of Educational Leadership and Information Technology Services.

The AISD Technology Coordinator spearheaded the technology training efforts in the AISD. An AISD Staff Developer is also a member of the Research Team and led the training and implementation efforts for the elementary levels. The Webmaster is a doctoral student in School Psychology with strong technical and research expertise.

The Ysleta Independent School District (YISD) partners with the AISD in developing and evaluating project activities. The YISD includes El Paso which is urban with a 75% minority enrollment and is located in southwest Texas. The Program Coordinator of the Magnet High School coordinates implementation and evaluation in YISD. A network of elementary, middle, and high school teachers in El Paso are being identified to serve as partners to the AISD cadre of teachers for implementation of the WWW based prototype lessons.

Ysleta ISD is in the El Paso area which is markedly different from the Aubrey area. Aubrey has little ethnic

diversity, is rural, is in North Texas, and performs at a high academic level; El Paso is on the southern border, is urban and has a high concentration of minority students. This partnership provides an opportunity to share and evaluate lessons in two diverse settings. It also makes possible Internet-based communication between students in the two districts.

Over the past five years the Aubrey ISD has collaborated with TWU in the development of a new teacher education program. These efforts have focused on improving classroom instruction. With support from Texas Woman's University, a series of staff development sessions were implemented for AISD and other rural districts. An important additional benefit of this effort is the modeling and mentoring of effective instructional uses for the Internet provided by trained teachers.

Texas Women's University

The University Professors serving on the Research Team are instructors in educational technology and serve as University Liaisons to three rural districts. They have previously implemented technology-focused research in school settings and published and disseminated findings appropriately. The AISD Technology Coordinator, serves with them as the Texas CPB Summit Team.

The project provides outreach including sharing of experiences and products within the district, with the University and through Internet with a partner program in the El Paso area, the Ysleta Independent School District, and eventually with Summit Teams of the Corporation of Public Broadcasting.

Corporation for Public Broadcasting

University professors from TWU and school technology coordinators from AISD were invited to participate in their Fourth Summit for Educators held in Dallas during September of 1997 by the Corporation for Public Broadcasting. These Summits were co-sponsored by the National Council for Accreditation of Teacher Education (NCATE). This team was the only representative from Texas. This opportunity facilitated communication and possible collaboration with over 100 summit teams across the nation who participated in these summits. The summits focused on integrating technology into the curriculum. The partnership with Ysleta ISD grew out of the Dallas CPB Summit.

Structure of the Program

Tasks

1. TWU, AISD, and YISD design and implement the project.
2. Select, organize, and support a representative Expert Team. Define roles, responsibilities, and timeline to accomplish: (a) assessment of lesson plans, (b) selection of exemplary lessons from various levels and content areas, and (c) implementation of further utilization and evaluation within AISD and YISD.
3. Select and prepare cadres of university students to support classroom teachers during training days.
4. Establish a website to be linked to the Corporation for Public Broadcasting, Texas Woman's University, and Aubrey Independent School District.
5. Prepare teachers at all levels in AISD to integrate the use of WWW resources into their classroom instruction in ten training days.
6. Implement and evaluate lesson plans developed by each AISD teacher who was trained.
7. Implementation of prototype Internet based lessons by an established AISD and YISD teacher team to encourage further collaborative efforts of integrating Internet resources into classroom instruction. This also encourages reflections on teaching and learning and possible classroom interchanges.
8. Share the new curriculum and the collaborative process at university, district, and conference events as well as electronically with other summit teams.

Teacher Groups

Three distinct collaborative groups of teacher participants were established: (a) identification of AISD teachers to be trained, (b) the Expert Team, and (c) Partner teachers for the YISD collaboration. The first group included all K-12 teachers, who were trained to utilize Internet resources in their respective classrooms. Some needed more training and assistance than others. Some did not wait for formal training to begin exploring the possibilities.

The second group was a seven member Expert Team which represented elementary, middle, and high school levels. This team, trained by Education Service Center Region XI, taught teacher inservices, and provided classroom support for teachers, evaluated lessons submitted after the first testing, identified peer teachers to utilize and evaluated lessons, and selected Partner Team members. The Expert Team also shared products in CCPDC seminars and with University content specialists.

The third group was comprised of partnering teachers. Pairs of AISD and YISD teachers communicated electronically about their utilization and evaluation of lessons as they were used in their classrooms. The lessons become available to others through the AISD, TWU and CPB/NCATE web sites.

Implementation

Curriculum Development

The first step in teacher training was a series of voluntary after school sessions for technology novices in February 1998. These sessions provided basic experience in connectivity including use of Netscape, bookmarks, and accessing some valuable educational sites. This orientation was followed by two inservice days. One day centered on lesson development and the other on analysis of appropriate Texas Essential Knowledge and Skills competencies for

teachers' grade levels and content areas. The third training period provided opportunity for the teachers to develop lessons in their own classrooms with Expert Team members available in their building for specific help and encouragement. Each teacher was expected to develop, teach, and evaluate at least one lesson during this semester. As lessons were implemented, other teachers at their grade level or in their content area were encouraged to field-test them. The best of these lessons were identified as models for sharing with other members of the CCPDC, with TWU preservice teachers in technology seminars, and with teachers in the Ysleta Independent School District.

Teams

The Expert Team was responsible for design and implementation of training sessions. Others involved in implementation included the Research Team (university professors, AISD technology coordinator, AISD staff developer, and the WebMaster), the Partner Teams (teachers from AISD and YISD selected to share lessons and insights), technology professors from TWU, and university liaisons who share curriculum with other CCPDC districts.

The Research Team provided training seminars for CCPDC students on the integration of Internet and collaborated with other professors on enriching university classroom instruction. They also communicated with other CPB summit teams to share the process and products developed by the AISD Implementation Team. Products were posted on class web sites and the CCPDC web site.

Technology Utilization

The Aubrey District has been a leader in staff development and in technology. In May of 1997, AISD received a state grant which helped to provide the needed infrastructure and funds for staff development. Both the Aubrey Independent School District and Texas Woman's University are committed to integrating technology into the classroom. With the support of an AISD small district grant and the 1997-1998 CCPDC grant both of these entities have the necessary infrastructure to support teacher training in effective utilization of WWW resources in classroom instruction.

This massive technological change in AISD was possible because of the small size of the district, its history of staff development and performance, the level of technology available, and the quality of the leadership team. The Superintendent and Technology Coordinator spearheaded the district effort and it was enthusiastically supported by the Principals and the Staff Development Coordinator. Teachers varied in their technological confidence and interest but comprehensive training and extensive support has resulted in significant classroom innovation.

Web page links between the CCPDC university liaisons, mentor teachers, student interns, student teachers has increased communication among participating groups. Telecommunication between Research Team Members and the Expert Team Members has also facilitated project management. Changes that seemed extremely difficult have become possible and easier as the project gains momentum.

Internet access has now been installed throughout the district. All AISD teachers have been trained to develop, utilize, and evaluate a lesson plan utilizing Internet resources. Each of these teachers will have implemented at least one such lesson during this school year. During teacher training, TWU students served as substitutes in classrooms providing support for the teachers and also gaining valuable experience for themselves.

Lesson plans have been assessed by the Expert Team and the best at each level or within each content area is being implemented and evaluated by a Partner Team which includes an AISD and a counterpart teacher from YISD. Both the implementation of the lesson and reflections on its effectiveness are facilitated and enhanced by electronic correspondence between the AISD and YISD teacher team.

Implications for Technology in Teacher Education

This collaborative effort supports the professional development of (a) preservice teachers at three levels, (b) the mentor teachers in two districts, and (c) the teacher educators at the Texas Woman's University. Thus students, mentor teachers, and university personnel are enriched and sharing across the country is supported.

The TWU preservice teachers participated in field settings for two semesters as interns prior to becoming residents in a third placement. During this three semester period the campus technology seminars address connectivity, productivity, and integration. The opportunity to participate in field settings in active learning communities pursuing integration of technology is an important experience for them.

Collaboration of teachers across grade levels and content areas extended teachers' professional development within the district settings. Their active collaboration with liaisons and other professors also enhanced teacher education in the university setting. In addition this collaborative adventure provided a framework for cross-cultural exchanges between teachers in contrasting districts and provided a context for collaboration among their students. This sharing of resources was expedited by access to communication technology.

Establishing connectivity between professors, interns, residents, and teachers is the foundation for ongoing electronic communication and individual professional growth. The AISD district-wide effort enhances the professional development of classroom teachers by supporting them in developing skills necessary to utilize Internet to enhance their teaching and to share their plans and reflections with their counterparts in distant classrooms. University seminar presentations by these mentor teachers expanded the learning of preservice teachers and university

professors in the area of using Internet as a resource. The availability of these resources on the AISD, CCPDC, and TWU web sites supports dissemination and encourages reflective interaction between professional educators locally as well as nationally.

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Project STAR: Teacher-Designed Professional Development Integrating Mathematics, Science and Technology

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In this era of rapidly changing technology, educational adaptation of technological innovations is creating a different role for the teacher. Inservice teacher professional development can no longer be a workshop forum in which teachers are handed "teacher-proofed" materials to take back to their classroom. The "one-size-fits-all" type of learning materials that grew out of the factory model of education has created a monotone in the classroom that students are no longer willing to accept. Modern technology has ushered educators into a new era where student learning can be individualized and integrated with a student's needs, interests, and skills. This approach to learning can be threatening to teachers who entered the profession with traditional skills and expectations for maintaining a controlled, structured learning environment.

Retrofitting today's technology into the traditional textbook-based classroom limits the potential for these new tools. A more constructivist model for education has emerged, but if teachers are to understand how to facilitate such constructivist learning, they must be allowed to experience it themselves. Teachers can engage in professional development opportunities that place them in the learner's role, using technology in all phases of the process. Today's teachers should view themselves as the head learner in their classroom, serving as a motivator and facilitator of student learning in a more collaborative environment.

Although students are expected to collaborate with peers on a regular basis, such collaboration is rare for their teachers. In the corporate workplace, especially in technologically related businesses, employees tend to work in project teams. Ironically, educators are not usually allowed the same opportunities that they are expected to provide for their students as they prepare them for future careers.

Initial Description of the Project

Project STAR (Students and Teachers Achieving Results) is a technology-based professional development program intended to provide integrated mathematics, science, and technology experiences for all secondary science and mathematics students in over sixty Houston Independent School District (HISD) schools. The project was funded in 1995 by the National Science Foundation (NSF) and Advanced Research Projects Agency, and is managed by the HISD.

Project STAR's goals and objectives will be met through the implementation of a professional development program that was initially described as *train-the-trainer* model. After the project was underway, it became evident that a more collaborative approach was needed to provide a more suitable environment for learning. Acquiring technology skills was only a part of the process needed to achieve integration of technology into the curriculum. Eight classroom computer focus centers, containing five computer stations in each, provided the opportunity for trained mathematics and science teacher-facilitators to model innovative teaching strategies for fellow teacher-participants. Project STAR is unique in that it is a pilot research project that operates within the HISD school system—the fourth largest district in the United States. Recent project growth is directly attributable to the coordination of area resources in response to teacher-identified needs and evidence of success from the first phase of the project. The project has survived many difficulties and shows great promise for promoting and supporting systemic change.

The development of Project STAR reflects a struggle to provide appropriate professional development within a rapidly changing environment, both inside the classroom and within HISD's district structure. Although specific conditions and outcomes are beyond the scope of this presentation, the original project goals, objectives, and anticipated outcomes are provided for background information.

Initial Goals

1. Combine the use of telecommunications with model classroom-based science and mathematics professional development and preservice teacher education.
2. Involve the teachers in the continued development of appropriate instructional assessment models using resources available on a district wide network.

Initial Objectives

1. To increase students' academic performance;
2. To increase the quality of mathematics and science pedagogy;
3. To develop advanced telecommunications support and information nationwide; and
4. To provide telecommunications information infrastructure incorporating a wide variety of information technologies.

Initial Outcomes/Expectations

Project STAR participants will learn how to use telecommunication to:

1. develop curriculum units to be placed on-line that address national mathematics and science standards and use available Internet resources;
2. use effective instructional strategies in teaching science and mathematics to their students;
3. incorporate instructional strategies and assessment into the curriculum units;
4. develop teacher training modules using technology;
5. share and enhance curriculum units; and
6. access regional, national, and international sources of information.

Site visits by NSF representatives and HISD's staff re-evaluation of existing conditions prompted revision of project goals and objectives.

Reconceptualizing the Project

Essential Question

In a comprehensive review of HISD's existing professional development opportunities for the integration of mathematics, science, and technology, a pattern emerged. As stakeholders discussed conditions needed to fulfill the vision, the essential question for planning became: "How can Project STAR be used to enrich, focus, and extend existing mathematics, science, and technology programs through a variety of human and telecommunications infrastructures?"

Vision

A recent series of collaborative sessions with HISD staff, community corporate sponsors, and area institution... representatives produced a vision statement that re-focused the project. It states:

1. As lifelong learners, visionaries, and risk-takers, students, teachers, and administrators live and learn in a technology-rich environment with unlimited access to virtual and actual resources. Students and teachers collaborate with peers and members of other generations while positively contributing to an advancing society.
2. As change agents, teachers and administrators model, facilitate, coordinate and coach individuals in the learning process supported through technology, to empower individuals as lifelong learners. As collaborators, teachers build collegial relationships and an evolving knowledge base so that teaching and learning communities are enriched through peer-to-peer, multi-aged, and intergenerational groups.
3. Administrators actively pursue and foster collaborations that cross boundaries and open doors among schools and the community so that the process of teaching and learning mathematics and science through telecommunications technology is enriched in a global world.

Support Systems

The original plan was for Project STAR to coordinate community input for teachers' professional development and classroom support. Those outside of HISD expressed a desire to help, but felt that coordination was best accomplished from within the district. In response to the essential question, the following infrastructures were identified and will continue to be developed.

Technical Support. To address existing technology support problems through HISD's help desk system, a Project STAR staff member will investigate the nature of support needs as problems are resolved. Data will be used to recommend changes to the technology support process currently in place.

Telecommunications. A district-wide area network of ISDN and T1 connections to all HISD schools provides telecommunications access for teachers to share their work. Through HISD's Wide Area Network, teachers have access to the Internet and e-mail. At least four secondary schools have videoconference labs and all middle schools have CU-SEEME equipment. The Houston Museum of Natural Science and National Aeronautics and Space Administration (NASA) have established interactive contacts with some schools.

Peer Support. Teachers provide support for one another within the training program, and are showing initiative in working together in other training settings. They need more support in arranging time to work with their planning partners at school, to use the Internet and related computer applications in the development of their lessons, and develop and deliver inservice opportunities for their fellow teachers. Campus principals and administrative district superintendents will be included in the planning process to help teachers acquire training and subsequent planning

support. For instance, Project STAR is assembling information to circulate one uniform application for all summer training that will be available to secondary mathematics and science teachers and relates to Project STAR's program.

Organizational. Various departments within HISD and external organizations have begun to work together in addressing teacher professional development issues through Project STAR. A long-term process by which all areas of HISD and interested organizations can work together in an efficient, coordinated, constructive manner will be established with the assistance of upper level HISD management.

Interim Evaluation

The initial series of workshops served to improve nearly 300 participant teachers' computer literacy and technical skills, but more attention was needed in the areas of:

1. Teacher-to-teacher collaboration;
2. Time, equipment, and support for practice;
3. Integration of mathematics, science and technology; and
4. Establishing a safe environment for risk-taking.

Collaboration and Teacher-efficacy. Although telecommunications were described in the original project goals and objectives, the role of technology in supporting the collaborative nature of the work was not specifically addressed. Processes for integrating mathematics, science, and technology were also not clearly developed. Initially, there were several hidden learning curves that teacher-participants were expected to navigate with little external support. They were rarely granted extra time during their teaching day to develop and practice new technology skills. Teachers were also fearful of straying from the traditional teacher-directed coverage of standardized test requirements. They were worried about wasting class time with complicated technology-based teaching tools in which they lacked confidence. Those who managed to attain the technical skill level necessary for publishing lessons were uncomfortable with sharing their classroom activities because they were uncertain of the quality of their work. Their confidence was further eroded when NSF site visitation team members criticized practice web home pages that teachers had generated during training sessions as "vanity pages."

Focus Centers. Two focus center facilitators (one mathematics and one science teacher) were designated for each of eight campus research sites. At least one of the facilitators was located in a focus center classroom. Unfortunately, center facilitators were not closely paired by grade level or content. The lack of common students, common concepts, and common planning time made it difficult for the teachers to collaborate in the development of integrated mathematics and science curriculum. However, their shared commitment to provide technology and Internet access for administrators, teachers, students, and parents has made an impact, to varying degrees, on each campus.

Revising the Project

A project director was chosen from the original teachers trained to be facilitators in an effort to find solutions to the pedagogical and efficacy issues described above. The project director had previously served as a campus-based science curriculum and technology coordinator. She to develop a more teacher-centered training program using her project experiences, fellow teachers' responses, in-depth conferences with project evaluators and key staff members, and an informal analysis of the district's level of success with Project STAR training,.

The refinement of Project STAR was guided by several teacher-driven factors:

1. HISD focus group discussions;
2. experience with the Coalition of Essential Schools (CES) Math/Science Fellows;
3. networking opportunities provided through NSF for the new director;
4. planning sessions comprised of teacher-trainers and local university professors; and
5. input from existing professional development programs within HISD's mathematics, science, and information technology departments.

Focus Groups. As part of a restructuring of HISD central support services, HISD personnel from all levels were invited to participate in a series of focus group discussions to determine the district's professional development needs. The teacher-related issues were closely aligned with the previous experiences in Project STAR. Ultimately, the general "lead teacher" concept developed to implement long term, campus-based teacher support became an element of the prototype for Project STAR's "coach" training described below.

CES Math/Science Fellows. The director and two HISD teachers who were consulting on the project participated in an NSF-funded professional development initiative known as the Coalition of Essential Schools Math/Science Fellows program. The two-year CES training program is a nationally based, resident training model with provision for e-mail communication between participants being the only technology component. CES stresses collaborative and reflective skills for mathematics and science teachers who participate in integrated, investigative learning experiences. The former director and lead facilitator for that NSF-funded project participated in a two-day planning conference with HISD and interested Rice University personnel to discuss effective ways to modify the CES model to suit a non-resident, urban setting with a technology-related focus.

NSF Networking. The NSF hosted two conferences in 1996-97 that brought together the directors and evaluators

of similar programs. The networking with technology-based research program personnel was instrumental in helping director gain a perspective on Project STAR's level of success and possible future activities. The importance of planned institutionalization was emphasized during these conferences.

Project STAR Coach Model

To assemble an effective team of teacher-trainers that functions in a collaborative work environment on individual campuses, mathematics and science teacher-pairs were recruited for a new form of training. The Technology Adoption Life Cycle (Geoghegan, 1994) indicates that teachers in the "early adopter" group have the most potential to be effective as change agents in their schools. Project STAR's application process seeks to identify early adopter teachers for participation in the revised program.

Philosophy. The basic philosophy of the training is based upon:

1. Teacher as learner;
2. Technology-rich learning environment for research and skills development;
3. Reflective practice, especially in examining personal professional growth;
4. Peer coaching, across the curriculum and between pairs;
5. Collaborative experiences as a learner and in curriculum development;
6. Investigations that foster the integration of mathematics, science, and technology while meeting HISD curriculum objectives; and,
7. Professional collegiality among participants, professors, and trainers.

Pilot STAR Coach. The 15-month Project STAR coach pilot training group began with a weekend planning conference, followed by a three-week summer institute at the University of Houston. The group then engaged in a yearlong follow-up training program. Activities include practice of peer coaching skills and applications of newly acquired content knowledge and skills with the use of technology.

Summer Guidelines. The three-week summer institute had three basic training components:

1. *Teacher-as-learner*, with guided technology-based investigations for mathematics/science pairs, led by professors or master teachers. Pre-determined outcomes were based upon sound curriculum guidelines and the basic integration of mathematics, science, and technology.
2. *Teacher-as-researcher*, with some freedom of choice in pursuing self-directed technology-based investigations at various locations throughout the community. Teachers learned how to write and pursue their own research questions in integrated investigative teams. Performance-based presentations were prepared under the supervision of instructional technology professors in university computer laboratories.
3. *Campus teacher-pair or team planning* to create classroom lessons using technology that reflect the new Texas Essential Knowledge and Skills (TEKS) competencies and to design campus-based professional development sessions. Teachers practice giving constructive feedback and using a tuning protocol process for refinement of their work.

Technology Skills. Training in providing technology-based teacher training on an individualized basis preceded the STAR coach training. The program allowed teachers to set their own pace, choose their particular areas to practice, and bring their own materials to develop. A teacher-curriculum advisor and a teacher-technical facilitator guided teachers in developing their own learning design. A printed guideline of skills provided the teachers with an overview of the types of computer technology skills considered essential to their technology needs.

Final Products. A final participant portfolio presented at the end of the academic year will demonstrate personalized professional growth and specific outcomes, including a published web-site lesson.

Community Collaboration. Members of the Houston area business and institutional community collaborated with HISD to increase the size and quality of the summer training program. Approximately 120 mathematics and science teachers are on track to become collaborative coach pairs. Some of the 30 pilot teacher-coaches will serve as teacher-trainers in the future. To implement the scaled up program, the University of Houston (main campus), University of Houston-Downtown, the Houston Museum of Natural Science, NASA, Space Center Houston, and SECME, Inc. (a national program to promote minorities in engineering) are joining forces. The University sites will be the main training sites, but teachers will visit the Museum, NASA, Space Center Houston, and City of Houston environmental sites to perform their self-directed investigations. Upon completion of summer training, selected teachers will develop technology-related classroom lessons to highlight the special technology resources at the Museum and at NASA. SECME, Inc. is joining with Project STAR's summer training program to develop a new national model for their campus support team training program. Key SECME, Inc. personnel will incorporate Project STAR's technological and collaborative training into their vision for a new national training model for their program

Efficacy. Teachers who have participated in the technology training and the more extensive coach training are very enthusiastic about their experiences. They express appreciation for the professional manner in which they

have been treated, and feel empowered to control their own learning. They have shown insight in the ways they now structure learning opportunities for their students.

Pre-service Education. The impact of this type of in-depth teacher development, occurring on the campus of major universities that are engaged in pre-service teacher education, is felt both at the public school and at the university level. Last summer's professors have been strong advocates of the project.

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Preparing Teachers for School-based Technology Leadership

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Futurists predict that for today's students to succeed in the next century they must not only be technologically literate, they must also know how to think and use technology as a partner in their work. School district central office staff can no longer keep up with the demands of individual schools for technology planning, staff training and daily technical support.

Over the past decade, the number of computers and related classroom technologies has increased substantially. In 1987, there was one computer for every 37 students; now the ratio is one to seven (Technology Counts, 1997). While more than half of the computers are located outside of computer laboratories, only 15% of the nation's teachers have had at least nine hours of technology training (Technology Counts 1997). What can school districts do to prepare teachers to take advantage of the new instructional tools?

This paper describes a partnership developed between the Baltimore County Public Schools and Johns Hopkins University. The purpose of the partnership is to train teachers to become school-based leaders in technology through a 36-credit graduate program in Technology for Educators. The paper is divided into three sections: (a) the setting and the institutions; (b) the development and implementation of the Masters degree program; and (c) the emerging impact of the training effort.

Partner Institutions

The Baltimore County Public School district is the nation's twenty-fifth largest, comprised of 159 schools spread over an area of 610 square miles. Some of the schools are located in urban settings, others in the suburbs, and still others are rural schools. The district's Department of Information Technology works with each of the principals to provide technical and curricular support to the instructional program in each of these diverse settings. The Department has established a system of Technology Liaisons, including a representative from each school, charged with providing local support for computer-related instruction.

Technology Liaisons were established for two reasons. First, local ownership of the technology is considered an effective link with the district's site-based approach of governance. Each school develops and administers a school improvement plan that incorporates technology into the instructional program. In addition, the district office does not have sufficient personnel to maintain a constant presence in each school. The Technology Liaison helps fill the gap. The Technology Liaison approach is limited by the local representative's technical capabilities and by the ability to encourage and support school efforts to effectively plan and use instructional technologies.

To help address these issues, Baltimore County engaged Johns Hopkins University as a partner in developing the local liaison into a true site-based leader in instructional technology. Located in nearby Baltimore City, the University was prepared to work with the school district to develop a cadre of technology leaders for the schools. The task was consistent with the mission of the University's School of Continuing Studies, Division of Education which calls for graduate programs that prepare educational personnel to become leaders and change agents, and the development of partnerships with educational institutions. The University already had a well-established graduate program in Technology for Educators administered through its Center for Technology in Education and the existing program provided hands-on course work in technology as well as project-based instruction on curriculum integration.

Development of a Collaborative Cohort

Baltimore County Public School and Johns Hopkins University began work on a new master's program in 1995. The goals of the program centered on three areas: (a) technical competence; (b) school-based leadership; and (c) the change process. The three areas directly addressed the expressed needs of district schools. Each school required on-site technical support and was charged with incorporat-

ing technology into the curriculum. Faculty needed staff development and support to effect changes in curriculum and teaching methods. The district and the University jointly determined competencies in these areas.

Competencies

Instructional technology administrators from the school system and faculty from the University collaborated to establish the competencies for the cohort students participating in this Master of Science in Education Technology for educators program. Selected competencies were based on guidelines for graduate programs developed by the International Society for Technology in Education (ISTE, 1991) and the Interstate New Teacher Assessment and Support Consortium (INTASC). Competencies were designed to prepare teachers to: (a) plan technology use and provide technology resources; (b) apply research-based principles as effective instructional leaders and master practitioners; and (c) be change agents for promoting school improvement and evaluating school change. Specific competencies are shown in Table 1.

Key Elements of the Partnership

Selection of Candidates

Each candidate selected for this program had to meet the regular requirements of admission into a Johns Hopkins University School of Continuing Studies graduate program, and also had to be identified and recommended by the district and school administration as a master teacher with leadership potential. Further requirements included a minimum of three years experience at the elementary level, advanced computer literacy and demonstrated competence in instruction and classroom management.

Role of Principals and School Improvement Teams

Principals with cohort members who worked in their schools agreed to participate in two seminars per year on leadership and technology. The principals and school improvement teams also agreed to support the implementation of participating teachers' projects within the schools. The seminars served as a vehicle for updating the school and district administrators on the scope and direction of the course content, as well as a forum for presenting projects that incorporated current research about effective technology applications for instruction in schools. Classes and seminars were held in local school facilities, contributing to the authenticity and relevance of course content because students used resources available in their schools to apply what they were learning in the program.

Applied Projects

Cohort members developed projects in each of their graduate courses. Projects were related to the program

Table 1.
Core competencies for School-based Technology Leadership Master of Science in Education Technology for Educators Program

Technology Planning	Instructional Leadership	Change and Program Evaluation
Apply computers and related technologies to facilitate active learning and effective instruction.	Explore, evaluate, and use technology-based instructional strategies, including applications, educational software and documentation.	Demonstrate knowledge of equity, ethical, legal, and human issues of computing and technology as they relate to society and model appropriate behaviors.
Apply research, the principles of effective instruction, and appropriate assessment practices to the use of computers and related technologies.	Demonstrate knowledge of technology applications for problem solving, data collection, information management, communications, presentations, and decision making.	Identify resources for staying current in applications of computing and related technologies in education.
Plan school-wide technology configurations.	Design and develop effective instructional activities that integrate technology in order to meet the learning needs of diverse student populations, including students with disabilities.	Facilitate the design and implementation of educational computing across the curriculum in concert with individual school improvement plans.
Evaluate, select, and integrate technology into curriculum and instruction across disciplines for all students, including those with disabilities.	Demonstrate knowledge of uses of multimedia, hypermedia, and telecommunications technology to support effective instruction.	Implement staff development programs at school and district levels.

competency areas, including: (a) development of school-wide technology plans; (b) school and district level staff development programs; and (c) evaluation of technology implementation in relation to goals listed in school improvement plans. Components of the projects included applied research, implementation strategies, and evaluation of student learning.

For example, cohort members developed comprehensive plans for opening newly networked buildings and/or wiring plans for distributed networks in renovation projects. The students' plans added the dimensions of examining the purposes and potential outcomes of increasing access to technology and how it would improve the school's instructional programs. The courses in the graduate program provided students with the expertise necessary to take a leadership role in planning for technology, that was critical to the accomplishment of school improvement goals.

Other student projects focused on the integration of technology into the curriculum. In these projects, students demonstrated a thorough understanding of the potential of technology to enhance the curriculum and to improve learning. Students mastered multimedia tools and the Internet, included these applications in instructional units and, trained colleagues in their schools to use these tools. Projects became the basis for school-wide, and often district-wide, staff development workshops.

Building-level administrators benefited from the expertise that cohort members developed as a result of the program. Cohort members reached a level of competence that allowed them to take ownership of technology innovations in their schools, and provide support for implementation of their innovations. The district plan calls for a cadre of trained teachers to serve as liaisons assigned at the building level to facilitate the infusion of technology into schools. The students in this program are prepared to serve in this capacity. They are now armed with skills to make a difference in their schools.

Implementation Strategies that Worked

The cohort program variations were designed to focus on school-wide technology leadership and to develop competencies that prepare teachers to serve as local experts and change agents for their schools and school districts. Several factors led to the students' development as local experts and change agents. One was the location of classes. Most of the classes met in a local school facility. Field trips to other sites within the district were incorporated into the instruction. This required each of the graduate courses to use the resident hardware, software and network configuration available in district schools. Using the local schools also provided cohort members an opportunity to evaluate district-wide issues, such as: age and condition of building; feasibility for wiring, networking and upgrading equipment; expertise of administrators and staff; resources for procurement of wiring, hardware equipment, software and training; and parental expectations and support for technology in schools. District and building level support were key, not only for accessing the district facilities for course instruction, but also for providing information regarding plans for infusing technology in schools throughout the district. The district-level leadership for technology plans to use graduates of this program for key positions in Technology Literacy Challenge funds and Goals 2000 grants.

Personal characteristics of the cohort members was also a second factor that contributed to their ability to become experts and change agents in their schools. Demonstration of leadership potential was a criterion for an invitation to apply. Therefore, the students were highly motivated to become leaders, having already been identified by their principals as showing leadership qualities. Students were also intrinsically motivated and curious about the benefits of technology. They had the urge to be creative and the desire to be innovative—characteristics critical to technology leadership in schools. As evidence of the success of the program in preparing technology leaders, two students in the program have been recognized as Baltimore County Computer Educators of the Year by the Maryland Instructional Computer Coordinators Association for their site-based technology leadership.

Diverse thinking and leadership qualities of the students were the third and fourth factors in the success of the program. Although cohort members were primarily elementary teachers from a single school district, they used diverse applications of the theories and research presented in courses in their teaching environments. Courses were developed and taught by University faculty and adjunct instructors with experiences from districts outside of Baltimore County. Assignments were designed to develop new skills and understanding for individual students and to facilitate the application of those skills and knowledge in their own teaching situations. Cohort members exercised their leadership skills at the building level to obtain resources and the principals' approval to complete the project assignments.

Challenges to Anticipate

Instituting a graduate program in partnership with a local school system brings a set of challenges to both parties. The university standards for admissions and tuition rates must be factored into the partnership negotiations. The university must be willing to customize a program and commit resources to deliver the instruction, as well as to establish and maintain collaboration with the district and building level administration. The school system must commit to providing the facilities and technology resources for the program. Both institutions expose themselves to the political implications of a partnership, as well as to internal political ramifications that may arise from the process of

selecting students, locating sites for classes and providing technology resources.

Time is another challenge for a cohort of students in any graduate program. To complete the program according to the schedule, students were required to complete 12 credits per year for three consecutive years. This is a rigorous pace, in terms of both time and money, compared to the typical master's student who is allowed, and often needs, five years to complete the 36 credit requirement. Classes were held after school when teachers are tired and in the summer when their families and colleagues are on vacation. The new knowledge the students acquired brought new demands on their time and responsibilities for technology advancements within their schools that competed with the program for the students' time and attention.

There is often mobility in assignments within school systems. Mobility presents challenges in that teachers get assigned to schools where they have neither the commitment of the principal nor the technology resources for carrying out their technology implementation plans. They may be required to work with novice staff to develop grade level team instruction that does not include the use of technology. The new school may have other priorities for school improvement initiatives.

These challenges routinely face districts and universities that initiate special programs for cohorts of students from a single district. A customized graduate program can address these issues and provide support to the students and to the partnering district. The problem-based learning format then becomes a solution to the challenges presented in the authentic context of working within a school district.

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Collaborative Curriculum Development: Computer Education for Preservice and Inservice Teachers

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One challenge facing today's teacher education programs is how to teach student teachers to effectively use computers to support the curriculum. Equally challenging is the task of teaching inservice teachers to integrate computer technology into the curriculum. While computers have revolutionized business and industry, education has been left behind (Bell & Elmquist, 1992). Though many factors limit teachers' use of computers as an instructional tool, computer education for preservice and inservice teachers is a critical component of successful integration (Office of Technology Assessment, 1988, 1995).

This paper describes a project designed to help student teachers and inservice teachers work together to integrate technology with their instruction. In this project, student teachers and inservice teachers were, paired into student/mentor teams. Student teachers had some experience with their university coursework, Prior to participating in this study, secondary education student teachers completed a core computer course and a computer programming assignment during their teaching methods course.

During the junior and senior years of their undergraduate teacher education program, the student teachers were required to complete a core computer course in the use of computers in their curriculum. The core computer course introduced the student teachers to the operation of computers, software selection, and basic computer programming. During their teaching methods course, the student teachers received instruction in using computers in the curriculum, including instruction in the various types of educational computer applications, programming techniques, and the use of multimedia authoring systems. The student teachers then completed a discipline-specific computer programming assignment as part of a multi-disciplinary group of students (Breithaupt & Wentworth, 1996).

The inservice teachers did not necessarily have a background in computer-based instruction, but were selected because of their desire to learn to use computers to support their curriculum. Student teachers were paired with an inservice teacher and they collaboratively developed computer support for the curriculum during the student teaching practicum. The collaborative effort was support by faculty, staff, and graduate students at a large private university through the structure of a school-university partnership.

A resource team provided support to the student-mentor teacher teams' efforts. Participation of resource network consultants was unique depending upon the needs and requests of the individual student-mentor teacher teams. Most of the resource network consultants worked with one set of student and professional teachers, while a few assisted several of the student-mentor teacher teams.

Outcomes

Participation and experiences of each student-mentor teacher team was unique to that pair of teachers. While not every teacher became an expert in computer integration into curriculum, each made progress towards that goal. Teachers who did not use computers prior to this study learned to use them for classroom management and World Wide Web searches, and began discussing the use of computers for instructional purposes. Similarly, teachers who were already using computers as a management tool began assigning computer-based and web-based projects for their students and sought other methods for increasing the instructional use of computers in their curriculum. Finally, teachers who had already used computers to support their curriculum learned new programs, new methods, and launched development efforts for new computer-based curricula.

Support from the university was not limited to helping teachers learn to use the World Wide Web and multimedia authoring programs. Nor was it limited only to helping teachers understand and apply computer-based instructional methods to their curriculum. Support from the resource network and the university also included help obtaining grant funding for new curricula, site visits to help school and district media personnel support the new

technologies, and setting up and maintaining a listserv for teachers in the same teaching discipline.

An unanticipated outcome was identified by the inservice teachers. Because the student teachers began their student teaching practicum having already received a strong background in computer use and integration into curriculum, they became the more expert member of the student-mentor teacher team. The inservice teachers reported that, although they could not have done anything new with computers without the support of the resource network, they learned more about computers in the curriculum from their student teacher than from any other source. At the same time, the student teachers were benefited by receiving guidance from their experienced mentor teacher on using their computer skills in the classroom.

Not all teachers were willing participants in the project. A high school math teacher hesitated to participate in the study until directed to by district administrators. Despite the request by the district, this teacher refused to be contacted at school and attended only one meeting with a resource network consultant. The teacher discontinued participation near the end of the study, saying "I see no need for further participation [because] I really see no connection between computers and algebra."

Discussion

This project combined the development of computer supported curriculum with teacher education and professional development. Previous efforts to teach computer integration in curriculum have separated the education of student teachers and professional development of experienced teachers. Simultaneous teacher education and professional development has the potential to streamlining the process and yielding improved results.

Student teachers filled a valuable role in the Instructional Technology Integration Model. They brought the latest teaching methodology and their experiences using computer-based instructional methods to the student-mentor teacher teams. This helped the inservice teacher learn new skills and develop professionally. The inservice teachers brought their classroom teaching experience from which the student teacher drew guidance for the development of their computer knowledge and skills. The resource network consultants provide specialized knowledge and skills which were often beyond the scope of that required of a typical classroom teacher.

The results of this project indicate that collaborative curriculum development can be an effective method to teach student and inservice teachers to use computers effectively to support their curriculum. In addition, student teachers provide effective computer support to the inservice teacher they are working with. There appears to be promise for future work in collaborative curriculum development and instructional technology integration in the curriculum.

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Organizing an Effective Multi-District Professional Development Program

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Guilford County Schools

Conducting an effective staff development program that addresses the needs of a district's administrative guide lines is a difficult process. When you combine five school districts, each with their own individual needs, the task becomes gargantuan. The ABC Technology Consortium consists of five school districts and has, as its underlying foundation, the idea that students can achieve more when exposed to technology-rich lessons. What was needed was a program to train teachers how to create these lessons.

A program to address these needs was developed in the Summer of 1997 when representatives from five school districts (Guilford County, Person County, Stokes County, Surry County, and Wilkes County). In North Carolina, school districts are generally comprised of a county and all the towns and cities within the county. There is a large degree of state funding and state control and the State Board of Education has legal authority to replace a local principal of a school if students do not perform up to an expected standard. These five districts developed guidelines for summer training as part of the Federal Innovative Challenge Grant Program. The five districts formed a partnership called the ABC Technology Consortium and received a $4.9 million grant to be paid over five years. Phases of the grant included infrastructure creation, staff development, lesson development, and creation of a central repository of materials and best practices. Each aspect addressed one goal for improving student performance on North Carolina End of Grade Tests in reading, writing, and mathematics. Students in grades three to eight were the target audience. Results of the Summer of 1997 work can be found at: http://www.guilford.k112.nc.us/abc/home.html — under Thematic Units.

Planning Process

The first step was to get teacher representatives together to discuss and outline the nature of the summer program. Consortium districts sent key teachers and curriculum leaders to a session in April to begin planning. After much discussion and consideration of possibilities, these representatives came up with a tentative format for summer training that addressed issues of empowerment, networking, consistency, technology-rich learning, and the schools' professional environment.

Empowerment was deemed an important issue because there was a feeling that teachers are too often the last to know what is happening and why. The five counties encompass an area of about one-hundred and fifty miles from east to west. Teacher empowerment helped guide the discussion of how training sessions should be structured. The physical separation of project participants meant networking would be especially important to ensure communication among representatives from the different counties. Consistency also has implications with the multiple county nature of the grant. Technology-rich units were developed based on several factors: constructionist approaches, Gardner's Multiple Intelligence Theory, and thematic integrated design.

It became obvious from discussions with the planning group that teachers who would participate had not had sufficient technology training to feel comfortable with either the process or the equipment. With this in mind, workshop training sessions were planned. Training consisted of general Internet sessions, sessions on HTML for creating web pages, and sessions on using a web browser (Netscape Navigator Gold). After they had received training, participants were instructed to create units of study that incorporated highly individual and interactive webpages for their lessons.

The issue of professionalism goes hand in hand with the empowerment issue. The planning team advised that teachers often have been called upon to perform a task without being treated in a professional manner. To address this issue, the current training included snacks, catered lunches, notebooks, and pens—items that are common fare in business training sessions. Effort was made to make the nature of training business-like and professional.

Underlying Concepts

Teacher representatives thought that each participating teacher should have a common understanding of the concepts underlying the training. From discussions it

became obvious that there was a wide gap in background knowledge even among the curriculum experts. Based on this input some background information was provided for each teacher.

Constructionism involves going from the general to the specific as students build knowledge structures. According to Harel and Papert "If one eschews pipeline models of transmitting knowledge in talking among ourselves as well as in theorizing about classrooms, then one must expect that I cannot tell you about my idea of constructionism. Doing so is bound to trivialize it. Instead, I must try to engage you in experiences (including verbal ones) that encourage your own personal construction of something in some sense like it. Only in this way will there be something rich enough in your mind to be worth talking about." An example of this process would be the study of circuits in a science class in which students are given bulbs, wires, and batteries and are asked to make the bulb light in as many different configurations as possible. After they have explored and *constructed* a personal knowledge base, they can then study serial and parallel circuits in a more formal manner. This approach allows hands-on, active learning.

Howard Gardner has defined intelligence as the capacity to solve problems or to fashion products that are valued in one or more cultural setting. This pluralistic view of intelligence suggests that all people possess at least seven different intelligences that operate in varying degrees depending upon each person's individual profile of intelligences. The seven intelligences identified by Gardner are described below and the general characteristics associated with each of these intelligences were provided to the teachers.

1. *Linguistic intelligence*- refers to an individuals capacity to use language effectively as a vehicle of expression and communication (Examples: poets & writers).
2. *Logical-Mathematical intelligence*- refers to an individuals capacity to think logically, use numbers effectively, solve problems scientifically, and discern relationships and patterns between concepts and things (Examples: mathematicians and scientists).
3. *Spatial intelligence*- refers to the capacity to think visually and orient oneself spatially. In addition, spatially intelligent people are able to graphically represent their visual and spatial ideas (Examples: artists, decorators, architects, surveyors, inventors, and guides).
4. *Musical intelligence*- refers to the capacity to appreciate a variety of musical forms in addition to using music as a vehicle of expression. Musically intelligent people are sensitive to rhythm, melody, and pitch (Examples: singers, musicians, and composers).
5. *Bodily-Kinesthetic intelligence*- refers to the capacity of using ones own body skillfully as a means of expression or to work skillfully to create or manipulate objects (Examples: dancers, actors, athletes, sculptors, surgeons, mechanics, and craftspeople).
6. *Interpersonal intelligence*- refers to the capacity to appropriately and effectively respond to other people and understand their feelings (Examples: sales people, social directors, travel agents).
7. *Intrapersonal intelligence*- refers to the capacity to accurately know ones self, including knowledge of ones own strengths, motivations, goals, and feelings (Examples: entrepreneurs, therapists, etc.).

Integrated thematic units involves integrating several subjects to cover a broad topic, with a focus on connections between ideas. For example, the broad integrating topic of differences allows a teacher to draw on several curriculum areas in addressing the topic. In mathematics, differences in numbers, operations, and functions could be examined. In science, the differences among the plants and animals, terrain, or climates could be covered. In social studies, differences in countries or people could be addressed. And in communication skills, the differences in parts of speech, readings about differences, and observations of different story types could be used. It should be apparent that this broad topic allows many different areas to be under the umbrella of differences.

Several thematic ideas were mentioned as possibilities for the participants to consider as they thought of their particular unit plans: conflict, leadership, continuity & change, communities, patterns, systems, relationships, beginnings, balance & stability, communication, interactions, and diversity.

Implementation

After all of the above factors had been considered it was time to actually select teachers from the various districts to participate in the program. Each county in the consortium had one representative on the Consortium Board who was instructed to select from their county those teachers who had the greatest curriculum knowledge in specific areas. Each county had teaching superstars and through a process of negotiation, the broad range of teachers and disciplines were selected.

Six days of professional development and lesson writing were planned. Part the first day would be used for introductions and expectations. One day would address Internet basics and the remaining time would be used for development of content and demonstrations. The introductory training was also used to secure free e-mail accounts for each participant. Ultimately each county would have an e-mail server as part of the grant, but these servers were not in place when training began.

Teachers were divided into grade level groups, 3-5 and 6-8. In these groups, they examined test results from previous years to see which specific objectives from the North Carolina Standard Course of Study (state prescribed

curriculum) were not adequately met. The groups then decided which units they wanted to write. At this point they had two options: (a) they could write unit plans first and go to the Internet to find appropriate links, or (b) they could use the Internet as a source for ideas and then incorporate these ideas into the unit plans. Each approach worked well and groups used one or the other based on personal preference and previous experience.

Next Steps

The next step for the ABC lesson development project was to interface with the Learners' & Educators Assistance and Resource Network of North Carolina (LearnNC). LearnNC is a professional development and support program for North Carolina teachers and administrators that is intended to help transform K-12 instruction, delivery of instruction, and learning. LearnNC is housed in the Institute for Academic Technology (IAT) which is part of the University of North Carolina at Chapel Hill. The task this group selected was to create a database of teacher lesson plans for teachers throughout the state to use. this project was funded by business and industry and by the NC Department of Public Instruction and will be available to teachers within the state free of charge.

LearnNC will also provide a communication network to support collaboration among public schools, higher education, parents, the community and business. LearnNC will help educators infuse technology into their teaching and learning by doing it, rather than by being told about or trained in it. It is hoped teachers will change the ways they think about learning and instruction and the ways they structure learning experiences. As teachers and teaching change, LearnNC will become an instructional and resource network.

The design of LearnNC simply stated is to:

1. Serve all schools regardless of their infrastructures.
2. Fit the work schedule of teachers.
3. Provide just in time access to materials.
4. Facilitate collaboration.
5. Accommodate different learning styles.
6. Become a set of community network services.

The goal of ABC is to utilize the LearnNC delivery system to make units of study available across the state and nation. LearnNC has agreed to allow ABC materials to be fully accessible to any browser. In addition, there will be a high degree of collaborative activity within the state and across the nation fostered through this relationship.

Future

One of the goals of ABC is to raise test scores among low performing students. Several things will need to occur for this to happen. One is the provision of new lesson materials that address different learning modalities. The second area is the availability of materials as needed . In other words, we must expand the school day. To do this we propose making our materials available on the Internet so that students can access them from home, public libraries, community centers, or wherever they can find an Internet connections. Our materials must be produced in such a way that they can also be transported home on laptops, PDAs, as CDs playable on home gaming stations, videotapes, etc. Multimodal must be our byline for all materials developed.

With the availability of increasingly complex technology, there will be a continuing need for staff development and training. The ABC Consortium has a goal of helping keep over 1,500 teachers abreast of changing and new technologies to help students learn. This is ambitious, but with teacher involvement and energetic trainers it is an achievable goal.

One of the ways that we plan to reach out to all the grant schools is utilize video delivery of staff development. The use of video conferencing collaborative professional development activities will be used for all the grant schools. This process will also enable the replication of activities in each school district and in each school whether a part of the grant or not.

Ongoing evaluation of the training process has begun and preliminary results indicate a high degree of acceptance of the process and a high degree of satisfaction with the results. Time will tell whether this degree of satisfaction and acceptance will be replicated in the entire teaching population of the grant schools.

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A Model for Curriculum Planning that Works

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For the past year, teachers, parents, and students at Our Lady of Grace School have identified technology as a curriculum focus and taken steps to collaboratively integrate technology throughout the school. The challenges and aspirations of this endeavor, with no extra funding and in a low socioeconomic area, will be shared in this paper. In a social context of cutbacks and restructuring, this has been a timely exercise which will be of particular interest to administrators seeking a comprehensive approach to using school-based planning to help teachers integrate computers into their instruction.

Our specific context is a school with a collective low self-esteem, yet with a deep spiritual commitment to children and to each other as a community. The pervasive mood that "we never get anything" was expressed in the Parent Council school-wide phone questionnaire that identified technology as a curriculum focus. It was at this point that I was called in an advisory capacity as the board Computer/Curriculum Consultant. I was later hired as Vice-Principal at Our Lady of Grace School.

We were "starting from scratch" with computer literacy. Our focus for the first year began with the basics. We needed to develop the expertise to pursue the identified school focus. We had been persistent in acquiring, over a period of three decades, a school gym, library and two new classrooms.

Given a vision this school had already proved it could be persistent.

Key Features of the Model

The key premises of this model are three-fold and are fundamental to the implementation of this initiative:

1. The plan is comprehensive and spans three years. One key premise centers on the integration of Computers Across the Curriculum (CATC). Using technology in a concept-based integrated curricula offers the learner meaningful connections between academic subject matter and the inquiry into a problem. This means that teachers are looking for ways to ensure that the use of computers is first and foremost connected to classroom curriculum.
2. The *process*, when using computers in schools, needs to be collaborative. Students and teachers can become more comfortable, and gain new perspectives, methods and shared materials, when usage incorporates partnerships and practical, hands-on activities.
3. The *product* needs to be integrated across the curriculum. Peer work that allows student experts to pass knowledge on to others enables them to better internalize, connect and understand.

School-Based Computer Planning

There are many components of school-based computer planning which cannot be addressed in this short paper. The components which are highlighted here were foremost in our planning.

School-Based Planning Initiatives

The first stage in planning school-based curriculum initiatives for the implementation of computers across the curriculum was to develop a school Computers Across the Curriculum plan. Collaborating with partners and in divisions around integration of computers and competencies, identifying student skills & learning outcomes and determining fit with in-class curriculum began intensively in August and September, and was ongoing throughout the following months.

Curriculum Continuum within Divisions

The primary division began with graphics. This lent itself very well to integration with other activities in their classrooms. Teachers incorporated student drawings with journal work and themes while encouraging exploration of the drawing software capabilities.

Junior and intermediate divisions identified word processing as a practical beginning point that would readily integrate with existing writing and research projects. Specific skills and sequential activities were used to bring our students through "the basics" of word processing. The activity also included a classroom application. For example, a skills activity included editing a piece using different fonts and styles. A follow-up would involve applying this in their own short story. The intermediate division also worked with graphics programs.

With much discussion, guided by the School CATC team, a three-year computer plan was fleshed out in late

November. Curriculum initiatives and student outcomes were identified in the plan. These were worded in terms of demonstrable skills which were curriculum-based, rather than software-based. We began to consider what our process for evaluation might look like.

We began implementing a student-based program and student progress became evident in their confidence and in the products they were producing. Parents were getting excited and thought "we had arrived." But I had news for them! Two other components were beginning to emerge—teacher access/literacy, and hardware and software needs.

Teacher Access and Literacy

Professional development was tailored to meet the curriculum and teacher use initiatives identified in the school plan. Included were areas that all teachers would participate in (like word processing, graphics and desk-top publishing); areas of special interest to some teachers like curriculum planning and reporting; and areas to help students in the classroom like Internet usage and multimedia presentation software (see Lesson Plan page, http://libits.library.ualberta.ca/library_html/libraries/coutts/lessons.html).

We have developed several useful strategies to maximize inservice frequency and effectiveness such as frequent mini-workshops, held after school in conjunction with professional development days throughout the year; teachers becoming "teacher experts" in particular areas; and, on "snow days," grouping children so that some teachers receive inservice while others supervised.

Community Partnerships and Special Projects

From the outset, we were on the lookout for special opportunities which could excite the interest and involvement of many people. We wanted projects that would tie in with our own local needs and would be authentic learning experiences for the students.

We were fortunate to be approached by Apple Canada and have been developing this relationship. We plan to share what we learn about how children use Apple's new personal eMate computer in their daily routines. We placed two in the primary area and two in the junior area to try to provide access to all students in the school. In addition, this corporate partner will provide initial components of a multimedia and publishing workstation.

Our local community library invited us to participate in an application for Internet access which would be shared in community settings. I was most surprised to note how much more impact that invitation had on our Parent Council than did the corporate partnership. I was emphatically reminded of Chris Dede's thesis that model of distributed learning, locally developed through the community, is in the very best position to meet the needs of the low income locality and to help districts leverage their scarce resources for innovation.

Parents play an ongoing role through the school-based computer planning process. Our Parent Teacher Association has been very active and became involved in one of this year's key special projects. We are producing and publishing a school recipe book as a fund-raiser. Every student in the school is word processing his or her own recipe. Student experts then insert recipes from disks into a FileMaker Pro template which will allow students to record a voice message with each recipe. This recipe book will also be a slide show in which you can use a button menu to find and select a multimedia recipe. A cadre of parent volunteers from parent groups will provide much needed additional supervisory support throughout this lengthy process.

Acquisition of Resources and Equipment

Computers in the school were configured in a small lab of fifteen workstations. We had identified January as our target to begin Internet access and the use of our multimedia-publishing centre. We needed four workstations for our four ethernet drops and additional ethernet drops and a workstations in each of our new intermediate classrooms.

A target pupil to computer ratio has been set at 3:1 at the elementary level in the province of Ontario. Funds to reach these targets have come in the form of Ministry of Education GEMS grants to meet the needs identified in the school plans. We hope to get funds for additional computers through School Parent Council and CPTA fund raising.

It now became evident that in about one more month most of the students would be ahead of the teachers! We had one Powerbook to be shared amongst 14 teachers. Paul Gilster (1997), warns us that we don't need a top-down decision to put a computer on every student's desk, we need to put a computer on every teacher's desk! We decided to make use of school budget program resources to plan for this need.

Evaluation

It was important that we establish clear criteria for the evaluation of the plan. What is success going to look like, who is going to measure it, when is it going to be measured and how are we going to follow up? We developed and set up a system of portfolios and diskettes for each student in the school from grade one to grade eight. These folders contained samples of the work each student did on the computer, both in the computer lab and during other computer times. Student evaluation also included a Skills Checklist with skills that were identified by teachers within each division.

An integration planner for each teacher or grade described the ways in which computer activities were connected with the classroom curriculum (themes, units, journals, research, inquiries, content and process, etc.). The integration planner also identified learning outcomes which were addressed.

Special Projects

Some of our special projects address technology use from a Christian perspective. We are a pilot project school working to identify appropriate and effective Christian Software. We are also forming an Internet subcommittee of the Parent Council to identify the most appropriate and effective Christian Internet sites.

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School Change Through Technology: The Role of the Facilitator

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In some ways, the current condition of educational computing is dishearteningly similar to what it was in the early 1980s. Now, as then, too many teachers have had little or no experience in using educational technologies. In spite of a constant flow of literature and advertising extolling the potential benefits of new technologies, teachers have not been adequately prepared to use them. Nor have most teachers been convinced that it is in their, and their students', best interests to do so. It may be true that many teachers have made great progress and are now using computers in wonderfully valuable ways; however, in almost every school we visit the situation is the same: the majority of teachers have not received even the minimal preparation necessary to operate their computers or use them effectively in their teaching.

A second similarity helps explain this lack of preparation. During the first few years, few microcomputers were available to schools and, consequently, most were placed in individual teachers' classrooms. Toward the middle of the decade, schools began investing more resources in purchasing computers and they tended to put all the computers in computer labs, moving those that had previously been in classrooms. This move has been explained in different ways: as an effort to ensure equitable use of the technology by all children; as the easiest way to deal with the problems of managing the machines and children's learning; or as a response to teachers' inability or unwillingness to use them in their own classrooms (Tucker, 1986).

Computer labs made the technology more manageable, but they also isolated it from the classroom, and decreased the likelihood that its use would be integrated with the rest of the school curriculum. Many teachers were unaware of what their students did in the computer lab. More recently, a combination of dissatisfaction with this separation, together with an ever-increasing number of computers purchased for schools, has given rise to a new push to "integrate" computers into teachers' classrooms. Many, if not most schools are now in the process of installing one to four computers in some or all of their classrooms.

The main challenge is that most teachers are no better prepared to have computers in their classrooms than they were in the early '80s. The intervening years, while computers were in labs where special teachers were responsible for them, did nothing to help educate classroom teachers about effective instructional uses of computers. Many have argued that the educational technology movement was likely to fail unless every teacher learned certain fundamentals about new technologies, including how to operate the machines, what software was available and what its potentials were, how software can be used to support the curriculum, and ways in which new technologies may transform school curriculum. In an October 1997 address at Columbia University, Vice President Gore clearly articulated the pressing need to educate not only those teachers already in schools but also the two million new teachers who will join the teaching force in the next few years—who are also poorly prepared to use technology in their teaching.

The challenge presented by the migration of computers from labs to classrooms is also a great opportunity for educating teachers. It becomes painfully obvious to teachers that they need all the help they can get to figure out what to do with these machines which have been placed in their rooms. Some supporters of classroom technology have recently presented theories of stage development in which simply having computers in the classroom pushes teachers from didactic to constructivist teaching (Sandholtz, Ringstaff, & Dwyer, 1997). But it seems much more likely that the machines alone are an insufficient spur, and that teachers need the help and support of others—peers, colleagues, administrators, and outside facilitators.

At present there is a broad consensus that we should invest heavily in wiring schools so that everyone will be attached to the Internet. Along with the push to acquire machinery for the classroom, this shows our national willingness to support educational technology, at least to the extent of supplying the hardware (McClintock, 1997). But there is (and always has been) less support for educating teachers so that they will be in a position to determine goals for instructional uses of technology. These goals should include not only how the technology can fit into, or

integrate with, existing classroom curriculum, but also how it can help shape curriculum in the future. For this task teachers need a certain degree of expertise.

We started the Center for Technology and School Change at Teachers College in order to work directly with schools and districts to help them achieve the goals of successful technology integration through knowledgeable teachers, and to study the ways in which technology is changing, or is likely to change, school life. Although our program has taught graduate classes and workshops in educational technology for twenty-five years, we felt that this mode of operation did not have enough of an effect on schools. We decided to work directly with schools through grants and contracts. We are presently engaged in projects with about twenty-five schools in the New York area: helping plan for the use of technology; helping elaborate educational goals and develop projects which will help them reach those goals; educating teachers about technology; assisting teachers in the classroom implementation of projects; and assessing the effect of technology in schools.

Schools of the future must plan for the effects of new technologies in at least three key ways. First, all students and teachers must become conversant with new meanings and uses of information so that they can take full advantage of information technologies. Schools should also create and foster their own technology cultures in which everyone shares the same general knowledge and usage of a commonly chosen set of tools. Finally, we should aim to use these tools to create a standards-based problem-solving curriculum, one in which students use sophisticated new technology tools to identify and solve meaningful and interesting problems.

Schools will benefit from university/school collaborations like the project we have developed. Although we do not want schools to depend on the efforts of outside facilitators, at this point in time and based on the historical evidence of the past fifteen years, it is clear that schools are not likely to integrate effective uses of technology themselves. Such collaborations are necessary and highly desirable because they can add a tremendous amount of excitement, energy, knowledge, and new perspectives to both parties in the collaboration. The primary question for us has been how best to work with schools to further our vision of the role of technology. In this paper we share some of what we have learned so far.

The Culture of the School

We begin with considerations about the school itself rather than with technology because the school is the more important. Although it may be true that, technology shapes our civilization, in our immediate world it is the inner workings of schools that determines the role of technology.

Schools have a long history of adapting instructional uses of technology to fit with existing practices. In spite of prophecies that film, radio, television, and other devices would revolutionize schooling, schools have instead managed to shape uses of technology and make them another tool to support what we now call traditional instruction (see Cuban, 1986). Despite the bandwagon type popularity of the Internet and its World Wide Web, what assurances do we have that schools will not have the same effect upon them as on past technologies?

For too long educational technologists have tended to assume that, because a technology had a certain set of potentials, simply dropping it into schools would actualize those potentials. As historians Carey and Quirk (1970) put it: "At the root of the misconceptions about technology is the benign assumption that the benefits of technology are inherent in the machinery itself so that political strategies and institutional arrangements can be considered minor." (p. 396) They were speaking of hopes and expectations for electricity at the turn of this century, but the same can be said about educational expectations for the radio or the computer.

The time has come for educational technologists to take the culture of schooling more seriously than we have in the past. Failure to consider this culture has been the cause of much of the failure of technology, as it will likely be in the future. The culture of the school encompasses many elements including the expectations and political skills of its leadership, the overall educational philosophy, personal relationships among those who work there, the nature and expectations of the student and parent body, and much more. All of these affect how technology will fit into the daily life in the school.

Moreover, each school is unique. It is true that schools in a given district, or perhaps even American schools overall, tend to resemble each other in many ways. Nevertheless, beneath this veneer, exist numerous and often subtle differences. Each school has its own history of how it deals with innovations, its own patterns of relationships that determine how and if innovations succeed or fail. Further, schools are not static entities — changing relationships, new leadership, and a myriad of new conditions, help determine how a school evolves.

There are several implications for those engaged in planning for technology innovation in a school. First, one must clearly understand the conditions that contribute to the school's culture (including the educational culture, moral culture, interpersonal culture, etc.). A second implication, is that we are in need of research that shows how technologies get integrated into the life of the school—particularly observational, ethnographic studies of classroom and school life. We need to understand more about the personal and inter-personal dynamic that accounts for success of new technology in some cases and failure in others.

A third implication has to do with a school's curriculum and pedagogical practices. These are at the core of a

school's culture, often so deeply embedded in its fabric that they seem nearly impossible to change at all. Yet, many school districts have placed computers in teachers' classrooms and expected "systemic changes" to occur in curriculum and instruction without other interventions. What can districts reasonably expect except the subversion of the technology into the existing practice of schools? How can administrators, district officials, technology coordinators, or outside facilitators work to change this culture? The answer lies first in understanding the existing culture and studying carefully the possibilities of new technologies for affecting the desired change.

Curriculum and Technology Goals

Since the microcomputer entered the school in the early 1980s, many educators have placed great hope in the possibility that it would transform teaching and learning. Several software application were supposed to effect this revolution including: LOGO and the teaching of programming, the use of simulations, and students becoming mini-scientists by collecting and analyzing information with database managers. Each little cycle of hope and subsequent disappointment led to questions of when, or if, computers would ever fulfill their potential.

It is important to be clear about just what this potential is supposed to be. The excitement generated by technology in the minds of educational reformers has rested on a vision of schooling that emphasizes that students are active learners, and that teachers are moving from a reliance on lecturing to more of a facilitating role (see Sandholtz, et al., 1997). This is a constructivist vision in which students take initiative in asking questions, gathering information, solving meaningful problems, communicating with others, and constructing their own knowledge of the world. This occurs with the help of teachers, other students, and the environment.

From the beginning, there have been problems in connecting technology with this vision of schooling. First and foremost, it ran head-on into a reality of schooling that was much different. Our dominant "factory" model of schooling proceeds from diametrically opposite assumptions and tends to apply technology in ways that reinforce it, such as drill and practice programs that are similar to workbooks. Further, the vision and its assumptions were never articulated clearly enough, so that it has been easy for schools to blend elements of the constructivist with the factory model so as to defuse any transformative power the technology might have.

The result has been that teachers are unclear about what it is that the new computers are supposed to accomplish, or why it is important that they be used. What they read or hear about does not fit with the reality of their classrooms, and so teachers' first reactions are typically to send children to the back of the room to use a math or language drill program.

Those of us who espouse a constructivist vision of schooling must be clear that what we need to focus on is not just the question of how to use a computer, but what we want education to look like and what is best for children. We can come at this question from two sides. If we begin with a clear vision of what we want education to be, then we can think more clearly of what technological applications can support it. But it is also possible that technologies support a constructivist view of teaching, and that teachers will come to a constructivist view through using computers in their classrooms (Sandholtz, et al., 1997).

In either case, we must work both sides of the equation. We need to show teachers the power of computer applications and also link these applications with clear curricular and learning goals. We must do a better job of fusing curricular goals to technology applications in ways that begin to demonstrate the power of the technology to implement new visions.

Working with Teachers

Based on the above considerations, we offer a set of strategies for collaborating with schools. We do not present these as definitive, but as a set of working strategies based on our experience and our study of technology in schools.

Developing a Common Culture. To the extent that a school works to create a common technological culture, its chances of institutionalizing technology-based change are enhanced. One of the ways in which outside facilitators can best serve the interests of a school is to provide a holistic, relatively objective, look at the school—its culture, history of successes and problems with technology, and configurations within the school that offer promise of desired change. This can provide a solid basis for helping a school assess itself (as far as technology is concerned) and develop a realistic plan for integrating technology. This plan can provide a process for educating faculty and students in the use of a common set of tools.

Integrating Technology Skills with Curriculum. Teaching teachers necessary computer skills has loomed large in the brief history of educational computing. Teachers are thought to lack skills including managing an operating system and using tools like spreadsheets and desktop publishing programs. Too often; however, training in these skills has proceeded in a curricular vacuum, with little or no reference to how the skills are relevant to what teachers do. The consequence has been that teachers rarely transfer skills learned in isolation to classroom instruction. For example, teachers need to see how a spreadsheet can be used to manipulate numbers and charts to promote sophisticated thinking and problem-solving strategies. This approach not only motivates teachers to learn how to use tools, but helps them think about how they can enhance their curriculum.

Projects. Planning for implementation of technology can begin with designing interesting and worthwhile

projects. Projects can be interdisciplinary and should involve the use of several kinds of technology-based tools including programs for planning, data gathering and analysis, production, and creation. For example, some students have developed projects on immigration and family histories using tools like hypermedia presentation programs, spreadsheets, and audio and graphics software. Other good beginning projects include creating a school store, publishing a newspaper, or creating a virtual class zoo. Some of these were existing projects or ideas, which have been enhanced through technology. For some teachers, this use of technology may help them consider new ways of structuring curriculum. In either case, a project approach can help teachers see the value of technology.

Individual Planning. In politics and environmental work, we have heard the phrase "Think globally, act locally." The same is true at different levels of introducing technology to schools. The school can be thought of as the global unit of planning and implementation and individual teachers seen as the local factor. Not only is each school unique, but each teacher within a given school is unique. Each teacher has an individual level of knowledge about technology, attitude toward technology, and methods and beliefs about teaching and learning. Real success with technology ultimately comes at the level of individual planning and one-to-one relationships with teachers.

Varying Methods of Educating Teachers. Because teachers are different from one another, their responses to different ways of learning about technology vary. For some teachers (and for learning about some software applications) direct instruction may be effective. At other times, in different situations, one-to-one tutoring may be much better. It may be effective and efficient for teachers to learn from students, either directly or simply by watching students work with software. And some teachers might prefer to learn alone, following written or on-line instructions. It is not that any one of these methods can be matched to individual teachers. In some cases, a given teacher might prefer to learn all software in the same way. But more commonly, factors such as the school environment, time available, the type of application, and the disposition of the teacher will combine to determine the best method in a given situation.

Process and Time. A common misconception about technology is that it is a thing or an event, something which can be "implemented," and is then in place—similar to the common belief in learning as something which can be delivered and has then happened, obviating the need for further learning. Many schools and administrators have tended to think of technological change as more or less instantaneous, as something to be taught to teachers in a few semesters which would then be "in place." In reality, technology is a process that occurs over time, a process of continual change and growth. Not only does the technology change rapidly, requiring continual learning, but teachers' attitudes about and their levels of expertise with technology go through stages and evolve over a long period of time (Sandholtz, et al., 1997).

In the past, outside facilitation has failed because it ignored some or all of these issues. For example, outside groups have tended to create what they believe are widely applicable packages of computer training, in the one-size-fits-all mold. These training programs often leave teachers and schools dissatisfied with results. A prime goal of outside facilitation should be to institutionalize changes so that schools will carry on by themselves. We maintain that this can be done only through paying close attention to the needs of individual schools and teachers and developing plans that meet their needs.

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Seven Stars That Shine Or Seven Tacks To Step On: Making Technology In-service Programs Work

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Technology in-service programs in secondary education rely on many factors to facilitate teachers' use of computers with their students. To promote a constructivist perspective, in-service programs should enable students to produce models, gather information, carry out simulations, and interact with software for learning concepts (Paakkanen and Viteli, 1996). This paper addresses conditions and factors that impede continuous professional development of teachers who need to learn skills for teaching with technology. These intervening factors; however, have little to do with the classroom. They reside in the culture of the school. The following descriptions and conclusions emerge from my experiences working and consulting with schools in Denmark and in four states in the USA.

Supporting the Technology Initiative

There is no substitute for charismatic school leadership that is well informed about integrating technology into the curriculum. Administrators must articulate their goals, organize the learning environment, and patiently withstand negative reactions of teachers who dislike the current emphasis on the use of computers in instruction. If a school's leadership does not address these issues, traditional teachers will argue that expensive resources are tied up with technology. To head off these claims, the school leader must take three steps:

1. A plan must be put in place for getting technology in-service programs organized by departments.
2. After the in-service program is under way, the administration must develop an annual evaluation system that includes documentation of how faculty are using technology for teaching.
3. School administrators must speak about technology goals repeatedly before teachers, parents, and students.

Other school issues may drive principals to seek political accord with conservative teachers by not taking these three steps. However, until school leadership commits itself to change by acting on technology goals, faculty utilization of technology will be slow. Reducing the funding for in-service programs or reassigning training personnel is the first sign that an administration does not have the resolve to reshape a school with technology. Nevertheless, my experience suggests that as administrators are replaced by new leaders who are committed to technology and can articulate a clear vision of how it can be used, there is a dramatic surge in new teaching competencies.

Continuous Professional Development

An ambitious professional development program is among the chief strategies for reaching the school's goals with technology. Regular workshops, personal coaching, and in-service sessions for large groups must be arranged within the school program (Bowers, Budd, Campbell & Rodriguez, 1997; Hannafin & Savenye, 1993; Rushcamp and Roehler, 1992; Sheingold and Tucker, 1990). However, the culture of the school may hamper this effort. Coaching duties, team try-outs, drama practices, and other non-instructional work assigned to faculty, may interfere with regular attendance at technology workshops. Family responsibilities may interfere with arrangements for training faculty after school. Regular offerings at in-service programs must be repeated and offered at different times to ensure all faculty can attend.

Successful in-service programs should involve department chairs who can help plan objectives and activities. Three or more teachers from a large department should be chosen to teach their peers in separate sessions. Teachers can sign up for specific workshops and attend three out of four offerings during a morning in-service. It is a mistake to group faculty in workshops without reference to computer literacy skills so additional workshops should be organized according to the proficiency of participants. In-service programs that provide one-to-one coaching can have a great impact on students' learning (Andrews, 1997).

Four major categories in support of constructivist learning in the classroom with technology include: communicating, researching information, structuring knowledge, and modeling of complex processes (see Table 1). These topics can be divided into many sessions for teacher in-service. Skill acquisition is a time consuming

process for faculty who are learning to integrate multimedia production into assignments for a course. A teacher venturing into this area for the first time may wish to join forces with the technology coordinator who can handle the technical details of creating a multimedia document while the teacher manages the instructional activity. Ownership resides with the instructor for the class and this type of team teaching can be flexible and of short duration.

Table 1.
Topics of Technology In-service

Communicating

1. Drafting in a Paperless Classroom.
2. Engaging in Collaborative writing via e-mail.
3. Sending drafts and responding to criticism of verse with a poet-in-electronic-residence.
4. Using white board software to brainstorm ideas.
5. Placing research results on a website.
6. Planning a project via e-mail with attachments.

Researching Information

1. Researching topics on the Internet, in library collections, and from reference works.
2. Identifying specimens from field study by sending images to a university.
3. Writing oral history from interviews of veterans and posting on website.
4. Videotaping visits of resource persons and digitizing video segments for a multimedia document made into a CD.
5. Posting a survey on a web page and reporting on responses after analyzing results with a database.

Structuring Knowledge

1. Organizing ideas into a concept map.
2. Structuring data categorically or chronologically in an outliner.
3. Making a time line.
4. Organizing a lab report with headings for figures, tables, graphs, and appendices for images and scanned photos.
5. Importing images from electronic cameras for cataloging.
6. Producing a multimedia program with menus that branch to specific headings of interdisciplinary research.
7. Producing a website that allows users to move through research organized by families of the animal kingdom.

Modeling Complex Processes

1. Simulating forces of an avalanche.
2. Making molecular models.
3. Making a concept map of the factors leading to World War I.
4. Simulating microeconomic activity.
5. Changing values, coefficients, and exponents of an equation defining windmill blades to maximize grinding torque.
6. Simulating chemical reactions that are too lengthy, too expensive, or too dangerous to create in a lab.

The Value of Needs Assessment

Most school technology coordinators already know the competency level of the faculty with respect to computer use. The tech staff notices which faculty fail to sign up for lab use and do not make use of computers in their classrooms. Each school should develop an annual needs assessment instrument for determining how well faculty can use e-mail, spreadsheets, and word processing software. To tap more advanced skill levels, the survey should query teachers for knowledge of web page construction, multimedia authoring, content specific software, and use of collaborative groups and paperless classroom strategies. Stages of concern surveys are particularly valuable for analyzing patterns with large faculties. Once the technology staff has analyzed these results, the coordinator can use a table to summarize each teacher's need for training in each software category. The data will suggest classroom organizational workshops for problem-solving and collaborative grouping.

Adequate Time for Learning

Innovators invest a large amount of time in learning to use software effectively. To move to an equally high level of proficiency, teachers need to move out of workshops into more concentrated one-to-one training. Even after receiving intensive personal coaching, teachers must work individually with the software by studying the manuals, the tutorials, and the template files furnished with the program. New users must try to create programs and files that run. Most complex software has a learning curve requiring five or six hours of practice spread across two days. The confidence to use some software well with a class may take a teacher ten or more hours of exploration. It also requires time to create student handouts and determine how the software will be used to accomplish course goals (Bowers et al., 1997). Therefore, to transfer skills to students, professional development programs must build in adequate training and time for teachers to learn new methods (Andrews, 1997).

As mentioned above, supervisors delivering in-service must contend with the responsibilities of teachers outside of regular class hours. During the week, regular E-mail announcements can be used to alert faculty to workshops that will be offered that afternoon. If the workshop is not mandatory, E-mail responses often indicate that teachers can not attend because they lack the time. Many allude to childcare logistics. A precondition for successfully integrating technology into course content is the requirement that teachers address the areas revealed in the needs assessment by attending group workshops and one-on-one coaching sessions, and investing personal time to master software for application in the classroom.

Annual Evaluation

Technology use and its effectiveness should be included as part of the annual evaluation process. Few schools use teacher evaluations as a means of promoting technology integration in the curriculum and wise usage of computer resources. Evaluation is often viewed by teachers as a capricious science in the hands of administrators. It is also difficult to change one's teaching repertoire when assistance with technology is not readily available in many schools.

Evaluation should assess whether a faculty member demonstrates progress toward personal goals with technology. School administrators should first examine needs assessment data to help the teacher form personal goals. Assignment letters should describe the personal objectives that the teacher should address to match school goals in technology for the year. These expectations should be written with the full participation and consultation of each teacher. This increases the ownership of the teacher in the process. Goals should coincide with the scope of the in-service program and be realistic regarding time demands and access to computers. Personal goals should strike a balance between the needs assessment results and the larger school goals.

Once goals are in place, school leaders should provide an in-service program to help faculty acquire new skills from a broad schedule of topics. The goal of this training is to promote skills for integrating technology into content teaching. In-service evaluations of each session should examine how well training supported teachers, and whether a rapid transfer of new skills to classroom teaching occurs. Workshop leaders should use this information to refine the scope of topics and the delivery of instruction.

At the end of the evaluation cycle, teachers can organize the documentation for how they integrated technology into their teaching. Portfolios should include a brief description of professional growth in the academic year. Evidence of software use can be documented through syllabi, handouts, assignment sheets, instructions, outlines, concept maps, printed webpages, multimedia documents, and samples of student work. The educational leader's task is to determine whether each teacher has met the school, department, and personal goals as set out in the assignment letter.

The Key Role of Department Head

The collegial approach to evaluation described above hinges upon the supervisor's ability to conduct this work openly and in a manner that fosters trust. The evaluation effort may fail when a department head does not model appropriate uses of technology. This situation is not unique to education—the CEO of a large designer clothing corporation requires a vast amount of technology training across all divisions of his firm, but that he was barely able to operate a computer and had never learned to type. When an academic leader cannot teach with technology, there is a parallel disinterest among his or her colleagues. In addition, department heads are rarely willing to evaluate teachers for technology integration when they lack computer expertise themselves. To increase the competencies of department heads, schools must choose individuals for these posts who have the willingness to learn new skills and are committed to supporting the larger school initiative of technology integration.

Participation of supervisors in afternoon workshops or attendance at academic conference sessions can aid in building new awareness of how to use software in each subject area. Ten days of paid attendance at workshop sessions over the summer can greatly increase the likelihood that teachers will use technology in their teaching. For example, the department chair of an English department requested training for him and his colleagues on how to make multimedia hypertext documents for their classes. After a four-day workshop, the teachers learned to include sound, graphics, and digitized movies in expository texts written by their students. Students were so highly motivated that they worked far beyond the expectations of the assignment. Department heads need to develop technology skills and experiences and demonstrate leadership for securing training for their faculty. In addition, one workshop day should address procedures for the evaluation process and the construction of portfolios to document progress.

Providing Computers for Teachers

To make all the other provisions of a well planned technology professional development program work, each member of the faculty should have a personal computer. Without one, teachers will have difficulty internalizing the information presented at in-service workshops and finding time to use software effectively (Sandholtz, 1991). Schools can rarely buy all the instructional staff a computer in one year, but a long range program should be developed to spread funding for these purchases across several years.

Some teachers adjust their schedules to provide time for learning new software routines. For example, innovators tend to use computers in all spare blocks of time between family and teaching responsibilities. Laptop computers are effective for enabling teachers to work at home or the office and can also be used in the classroom for teaching. Portable computers can be used for electronic mail, word processing, spreadsheet, webpage, or concept mapping programs. However, more powerful workstations and desktop computers should be made available for faculty who create large multimedia projects. If administrators fail to provide these resources, professional change will come more slowly because faculty need to spend large blocks of time learning to work with computers and software at their convenience.

Summary

A program of continuous professional development in technology depends on many factors. As student involvement and interest rises, teachers use of technology may enhance the reputation of the school. Addressing the seven factors described in this paper can help promote a culture for learning and using technology in the school. When these steps fail to fall in place, technology supervisors responsible for staff development are often discouraged because there is inadequate transfer of skills from the workshop to the classroom. If top level support for a comprehensive plan is missing, it will be difficult to deliver a coherent in-service program across the school year and summer. The integration of technology with subject matter hinges on the long term issue of teachers having access to computers, workshops, and the time to master software routines. This work is best accomplished in the context of collegial annual evaluation that guides the process. Many schools have not yet addressed these issues. Until they do, technology integration will appear only in the classrooms of self-taught innovative teachers (Brunner, 1992; Polin, 1992; Wagner, 1993).

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Supporting Technology in Schools: The Roles of Computer Coordinators

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In this paper, three areas of importance to computer coordinators in the schools are discussed: support by walking around, nuts-and-bolts support, and the computer coordinator as policy maker. I also analyze a day spent following a computer coordinator around an elementary school. That single day is examined in the context of a larger qualitative study in which various aspects of support for technology at Burnham Elementary School (all names in this paper are pseudonyms) were observed for a little more than one school year.

The computer coordinator may serve several roles, but the most dominant is meeting the immediate needs of teachers. This role is facilitated by a style of support which I call "support by walking around." Support by walking around includes any support given by virtue of being in the right place at the right time. Support by walking around was the computer coordinator's main method of serving the immediate needs of the faculty, and it was his best avenue for gathering information about technical and policy issues.

The computer coordinator felt his work was mostly "nuts-and-bolts." Nuts-and-bolts activities include tasks that require the expertise of a technician, which typical educators or administrators lack. The issue of nuts-and-bolts activities is significant because it consumes the majority of the time of the computer coordinator. On the surface, this would seem to imply that technicians should fill the role of computer coordinators. However, many activities, like training, are enhanced by someone who understands the classroom and the needs of the classroom teacher and can tie the activity into the context of the larger curriculum. Support by walking around also helps computer coordinators become knowledgeable about technology related issues in the school and helps them understand school-wide policy issues relating to technology.

This leads to the last area of concern for computer coordinators—computer coordinators as policy-makers. Although no major policies were made the day I spent with the computer coordinator, many of his activities were impromptu discussions about school technology policy. While many of the functions of the computer coordinator could be performed by a technician, the computer coordinator as educator and policy-maker has an opportunity to make a significant difference in the way the school uses technology to enhance the learning environment.

This study is an examination of the roles of computer coordinators and the ways that those roles go beyond technical nuts-and-bolts support. As a case study, this paper does not answer this question for all situations, but it helps to build an understanding of how a computer coordinator can function.

The Computer Coordinator in the Literature

Change processes and change agents in schools have been widely studied (e.g., Hall & Hord, 1987; Firestone, 1989; Fullan & Stiegelbauer, 1991). Others have looked specifically at computer coordinators. Strudler (1991) studied three elementary school computer coordinators and their roles as change agents. In his study, the computer coordinators ran programs in a laboratory separate from the regular classrooms; Burnham's computers were distributed among the classrooms. In each case, the goals were the same: integration of the computer into the teachers' curricula. The goal was better achieved when the computer coordinator became involved in the curriculum of the classroom and helped teachers see the value of teaching with computers. Most of the computer coordinators' work centered on immediate needs: for Burnham that was nuts-and-bolts activities, and for Strudler's cases that was the separate curriculum of the computer classroom.

Moursund (1985) also discusses the job of the computer coordinator. He emphasized a variety of skills necessary to be an effective computer coordinator including: general dedication to education and good managerial skills; specific knowledge of the educational system—including good teaching skills and an understanding of educational change; communication skills—with an emphasis on being a good listener; and technical knowledge in computer science and computer education—including knowledge of

teaching and learning theory as they relate to the computer field. While nuts-and-bolts knowledge is hinted at in several of the areas, Moursund's emphasis is on educational and managerial skills.

Loucks and Zacchei (1983) discuss support for innovations in schools. They state that a successful innovation requires a local facilitator, acting as ". . . cheerleader, building commitment early and maintaining it through constant encouragement; linker, bringing in outside expertise and ideas and linking resources and expertise within the district; and trouble-shooter, helping teachers solve problems and maximize their efforts. . .." (p. 29) The local facilitator is a school-based contact for a single project or innovation that involves many schools. The computer coordinator assumes this role for a wide range of computer-related innovations. In Burnham's case, Robert mainly saw his role as trouble-shooter, but the greatest success with the computer was achieved when someone, either Robert or the classroom teachers, took on the other roles.

Research Methodology and Procedures

This paper describes a case study that was part of a larger ethnographic study which looked at various aspects of support for technology in Burnham Elementary School, concentrating on three 3rd and 4th grade classes. I spent most of my time with these three classes and their teachers. I also looked more broadly at the 3rd/4th grade of Burnham Elementary School, the school in general, and the district.

Burnham Elementary School is a midwestern, public K-5 school with 19 classroom teachers and approximately 400 students. The school had an unreliable connection to the Internet, one computer in most of the 3rd, 4th, and 5th grade classrooms, a few computers shared by the 1st and 2nd grade classrooms, one older computer in each of the kindergarten classrooms, and one higher-end computer in the library with a networked printer and a scanner.

My qualitative methodology was shaped by situated-evaluation (see Bruce, 1993). In situated-evaluation, innovations are viewed as part of existing situations. Instead of viewing the innovation as a separate entity, it is part of the existing social system. Situated-evaluation techniques help us understand why support does not always meet its objectives. A situated-evaluation approach might find that the support was inadequate because the designers of the support did not account for the contexts and constraints of the situation, or it might bring about a better understanding of how the situation and the support interact to provide different support than what was originally intended.

Data for this case study came from a day that I spent with Robert, the part-time computer coordinator of Burnham Elementary School, during the 1993-1994 school year. I took notes about what I observed and expanded my notes through reflection over the next couple of days. As I read and reread the notes, I became aware of certain themes of interest, including: nuts-and-bolts support, support by walking around, and policy issues. I carefully coded each interaction for these themes, and I reread the notes several times, keeping these themes in mind.

The data from the single day with Robert was bolstered by the larger study. Before and after the day with Robert, I was able to observe him for brief periods and discuss issues relating to the computer coordinator job. Discussions were held with Robert, and other teachers in the school, and included formal interviews and informal conversations. The near-1000 pages of field notes from the larger study were coded, to enable extraction of any notes that related to the computer coordinator and analyze them in conjunction with notes from the day of observation.

The data from the larger study was supportive of what I saw during the day with Robert; however, at Burnham Technology Committee meetings, I was able to gain a better understanding of the potential impact of the computer coordinator on school policy.

A Day With Robert

Robert worked 15 hours per week as the part-time computer coordinator for Burnham Elementary School. I spent a day with him on Tuesday, December 7, 1993. In this section, I will discuss my observations and impressions of Robert's activities during that day and highlight the issues of: nuts-and-bolts, support by walking around, and the computer coordinator as policy maker.

I arrived at Burnham Elementary School at 8:15 a.m. and went to the library to meet Robert. He does not have an office and his desk in the library serves as a "home base." The library is frequented by teachers and students and is a convenient place for him to interact with others. Being situated in the library is also useful because it enables him to spend time discussing technology and school-related issues with Jackie, the librarian.

Before beginning his tasks, he talked to Jackie the librarian about the technology items that had been discussed at the faculty meeting the previous day. Then, they talked about other technology policy issues, including what to do about a modem that two teachers needed as part of the Global Schoolhouse Project. They discussed whether the modem should go in the classroom that the two teachers shared or in the library to be accessed over the network.

After Jackie left, Robert explained to me some of the issues involved with this double classroom. These teachers have four computers and will be getting more as part of the Global Schoolhouse Project. They do a lot with technology, but there is some resentment on the faculty about all the "goodies" that they have. Robert explained that part of the technology comes from grants, and part of it comes from the fact that their classroom is separated from the rest of the school by a small staircase, making it more difficult to share

equipment (such as a computer on a cart) with other classrooms.

Robert then tried to check his e-mail. Since the school's Internet connection was not working, he needed to use a modem, and for that, he lacked a piece of software. He thought that Cheryl, a 4th/5th grade teacher, might have the software. This afforded him the first opportunity to walk around.

Another item on Robert's agenda was an inventory of all the hardware in the school, including locations and serial numbers. Completing the inventory gave him a second opportunity to walk around.

The Burnham Technology Committee had decided to buy a hard drive for the secretary in the front office and two AppleTalk cards to allow two printers to be shared over the network. Robert was responsible for this, and it required him to go talk to the secretary in the front office a few times—yet another opportunity to walk around.

At about 8:45 a.m., Robert left the library to go talk to the secretary in the front office about the equipment he needed to order. On the way, he bumped into a teacher and told her that he would be getting some shareware for the computer she had just gotten in her classroom. He also spoke briefly with the chair of the school Technology Committee. When he got to the office, he discussed the paperwork necessary for buying the parts he needed. On the way out of the office, he spoke to another teacher who told him that her computer had not worked since Friday. He accompanied her to her classroom and fixed a simple problem. She also told him that she had just taken a workshop about ClarisWorks, and asked if she could get it installed on her computer.

During this brief period of time, Robert went to the office to work on one problem, and addressed issues with three teachers. In the first case, he reminded a teacher, whom he had not seen in several days, that he would be helping her in an effort to bolster her enthusiasm about her new computer. He then connected with the chair of the Technology Committee to maintain his awareness of what was happening in the school. Finally, he solved a problem that could have persisted for several days had the teacher not made him aware of it.

On the way back to the library, Robert walked by a 5th grade teacher outside her classroom. They discussed some personal matters and talked about the ClarisWorks training that she and another teacher had attended. She said that the training was at ESC (a state-funded regional training center for schools) and funding for ESC was changing so ESC might not offer as much training the following year. This encounter helped Robert in his role as policy maker and as local facilitator.

Robert continued on his way back to the library and again talked to the chair of the Technology Committee. They walked together down the hall and discussed some network software. When he had made it back to the library, he called a computer store to find the price for the parts he needed. He then spoke with the librarian for a couple of minutes and went to the front office to give the secretary price information about the needed parts.

At 9:25, Robert returned to the library. He sorted through some things on his desk, putting some things in a folder he had created for articles of interest, including a magazine that contained a review of some of the best software. He said that he intended to make this folder available for all the teachers.

Robert told the librarian about the teacher who wanted ClarisWorks. They discussed looking into how many copies they had and who was using it. They also discussed getting copies of the handouts from the ClarisWorks workshop that two teachers had attended and make them available to other teachers.

This interchange between Robert and the librarian brings out an important role of the computer coordinator that goes beyond nuts-and-bolts. Teachers have a limited opportunity to interact with other teachers and with the district office. Some teachers, such as Jennifer, feel more isolated than others:

> She said that she feels like she is alone with these problems. She's not sure if anyone else is in the same position as she is with the computer. She said she knows Sarah and Cindy [two other teachers at her grade level] are more advanced than she is. (field notes, 1/13/94)

One role that Robert played was to be a liaison between teachers and teachers as well as between teachers and the district. Jennifer might have little opportunity to communicate with many other teachers, but does communicate with Robert due to the nature of his role.

During the rest of the day, Robert was engaged in a variety of activities in which he:

1. walked around the school collecting data for the hardware inventory;
2. worked in the library on the software inventory;
3. ate lunch with several teachers and discussing technology;
4. loaded shareware on a teacher's computer;
5. discussed policy issues with the librarian and chair of the Technology Committee;
6. went to a classroom to look for some software he needed and helped the teacher fix an E-mail problem;
7. answered a technical question for the principal;
8. discussed the status of the network with a teacher;
9. found a printout at the printer that included several blank pages and discussed ways to prevent this from happening;
10. arranged times to provide individual training for two teachers;
11. helped schedule the use of the computer in the library;

12. told a teacher how to fix a software problem when she came to the library to pick up her work from the printer;
13. arranged to help out as a technical consultant for a special program in the school; and
14. answered questions over the phone for a teacher who was home sick.

His day was filled with nuts-and-bolts, discussions with teachers about various things and at various levels of importance, walking around and talking with people, and working and talking with people in the library. Most of the things he did were not of great importance when viewed individually, but taken as a whole, his pattern of contact with teachers—finding out about their needs, fixing their problems, and discussing their policy concerns—was very important.

Discussion: Nuts-and-Bolts, Walking-Around, Policy-Making

I looked carefully at the ideas of nuts-and-bolts and walking around. Nuts-and-bolts included things that a technician could do like: fixing equipment, installing hardware or software, ordering hardware or software, and cataloging hardware or software. Other activities included setting or discussing policies and developing curriculum (from planning lessons with or for teachers to finding appropriate technology for teachers). Training has elements of nuts-and bolts, but can involve instructional and curricular issues. Teaching basic computer skills and basic word processing can be considered a nuts-and-bolts activity; however, when a curriculum-oriented person includes suggestions for classroom applications, basic training can go beyond nuts-and-bolts.

Walking-around support included any support given by virtue of being in the right place at the right time. This included meeting people in hallways or at mailboxes, teachers who came to the library for another reason but relayed a need when meeting the computer coordinator. Non-walking-around support included planned activities in which the supporter or the supported goes to a place for the specific purpose of giving or getting support.

Robert started the day by reminding me that most of what he does was nuts-and-bolts. On that day, I counted 50 specific instances of supportive activities. Of those, 37 were classified as nuts-and-bolts activities. Most of the other 13 activities could be broadly defined as nuts-and-bolts as well.

Although Robert spoke about an interest in being more involved in curriculum, his most significant non-nuts-and-bolts activities involved influencing policy at the school level. His main influence came directly from his position on the Burnham Technology Committee, but his unique policy influence came from the insights he gained as he discussed policy issues with people from around the school.

In terms of policy, and in terms of direct support, personal contact is very important. Robert could better discuss these policy issues because of the personal contact he had with teachers. In addition, he was able to provide more direct support because of the personal contact he made; that is, he was more aware of the teachers' needs and better able to help them.

Of the 50 supportive activities on the day I followed Robert, I classified 22 of them as walking-around. That is, nearly half of the supportive things he did that day were unplanned. Several of the planned activities were a result of finding out about needs from earlier times when he had walked around. Many of the examples above showed Robert on his way to perform a task, encountering someone who discussed a policy issue with him or told him about a need for support.

Walking around and working directly with many teachers helped him to understand what was relevant to them. This included school-wide policy issues like equitable distribution of equipment, and specific concerns of teachers like the need for student typing skills and assistance. Typing skills is an example of an issue that is not necessarily obvious without continuous contact with teachers. This lead to issues that affected the entire school like when, if ever, keyboarding and typing skills should be taught.

Although Robert's work was mostly nuts-and-bolts, it went beyond that, especially in the area of policy. For some teachers, the nuts-and-bolts work was critical to maintain inspiration. In particular, teachers who were not very inspired to use technology, such as Jennifer, required nuts-and-bolts assistance to use it at all. Some teachers will find ways to get around minor technical problems and remain inspired in the face of adversity. Walking around becomes critical for less inspired teachers who may ignore the problem and refrain from using the computer until the solution comes to them.

Conclusion

Robert's work consisted mostly of nuts-and-bolts support, including solving technical problems and basic training. Although advanced training and curricular support were goals, the most significant support beyond nuts-and-bolts was in the area of policy. All of the support that Robert offered was helped by walking around the school and informally supporting teachers who needed help or wanted to discuss issues with him.

The computer coordinator can be technician, trainer, curriculum consultant, curriculum designer, and policy-maker. Support by walking-around can facilitate all of these roles by making the computer coordinator aware of technical problems and training needs, providing suggestions for how the computer can support the teachers'

curriculum, and the effects that policy decisions can have on different teachers.

We can learn a great deal about the potential of the computer coordinator from Robert. He maintained the technology infrastructure of the school and helped with basic training of teachers. His influence on curriculum and policy was not substantial, largely limited by his part-time status. He was in the best position in the school to understand the technological needs of the teachers, bring them new ideas, link teachers with each other and with resources outside the school, and discuss policies that affected all teachers at the school.

As teacher educators, we need to understand that computer coordinators need strong technical skills and the ability to provide basic training because these roles are likely to be significant parts of their jobs. If we want computer coordinators to influence policy and curriculum, they must have experience in these areas. Computer coordinators with an understanding of curriculum can link ideas from within and outside school. A computer coordinator with a good understanding of the change process can help to set policies that enable technology to help change schools in positive ways.

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TELECOMMUNICATIONS: GRADUATE, IN-SERVICE, AND FACULTY USE

Section Editors:

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The range of instructional uses of online resources continues to expand with the number of online computers in schools and universities and the speed with which text, images, and sound are transferre[illegible], a forum for teacher education and technology, features presentations that focus upon helping teachers use electronic resources to improve teaching and learning. The articles in this section all use Internet/World Wide Web (WWW) as their technology-based learning software.

Two grant-supported activities are reported upon. Beth McGrath and Joshua Baron of Stevens Institute of Technology, NJ, describe a nation-wide, public-private staff development program to help teachers effectively use the Internet and to integrate these resources into to their curricula and teaching. The project is supported by the United States Department of Education. Neal Topp, Neal Grandgenett, Robert Mortenson, and Elliott Ostler, all of University of Nebraska at Omaha, and Constance Hargrave of Iowa State University, present an Internet-based in-service model, work sponsored by the Helena Foundation. The program covers eight phases: partnership planning, program design, participant selection, awareness level instruction, experience level instruction, classroom integration, project closure, and dissemination.

Three articles address on-line communications. Beth Chandler and Cleborne Maddux at the University of Nevada, Reno, investigated students' usage of instructors' web sites. They present responses from 300 students at five colleges in the university that includes a discussion of the Web site components students found most useful. Sue Espinoza, Sharon Chambers, and Madeline Justice, of Texas A&M University-Commerce, describe experiences in using the WWW for meeting and providing on-line support for secondary pre-service teachers. Also discussed is the global educational community that emerges when produced resources are publishing work on-line. Jiang (JoAnn) Lan, University of Alabama-Birmingham, introduces a Web-based project through which across-the-curriculum professional development opportunities and continuous support for K-12 teachers has been provided.

Three articles discuss web-based graduate/in-service courses. Mark Stanbrough and Bill Stinson of Emporia State University, KS, describe the issues and awarenesses involved in developing a distance learning approach to graduate teacher education. Bob Gillan and Frank Fuller discuss a developmental structure they have devised for delivering college courses on the Internet. Morris Beers and Mary Jo Orzech, State University of New York- Brockport, present Educational Structures, a K-12 Internet-delivered curriculum tool that encourages use of the Internet in the classroom. Training on the use of this service constituted an in-service course.

Last, are two articles that look at different aspects of WWW use in education. Glenn Becker, of Thomson Technology Labs, MD, describes the creation of an Internet catalog that serves as a front end for student project, school resources, and approved Internet sites. Gertrude (Trudy) Abramson, Nova Southeastern University, FL, addresses issues related to the quality of articles found on the web. Suggestions for evaluation and methods of citing are included.

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Starting a Community-Wide Internet Turnkey Training Program for K-12 Teachers

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President Clinton's 1996 State of the Union address stressed the need for access and teacher development on applications of the Internet: "Our challenge is to provide Americans with the educational opportunities we'll all need for this new century. In our schools, every classroom in America must be connected to the Information Superhighway with computers and good software and well trained teachers" (President Bill Clinton, Jan. 23, 1996). His May 1996 announcement of the "21st Century Teachers" initiative set a goal to train 500,000 teachers in the use of innovative educational technology tools such as Internet-based resources (President Bill Clinton, May 29, 1996).

With movements such as Net Day helping to wire classrooms and the explosion in Internet connectivity in American homes and schools, more and more teachers, parents, and students are learning to "surf the net." Yet, little happens to actually change the way teachers teach and students learn without: carefully-crafted curriculum materials that meaningfully integrate compelling Internet-based resources; a long-term view of professional development that takes into account content, pedagogical, and assessment issues as well as technical mastery; and ongoing support for schools by organizations able to keep pace with the dynamic rate of change in the technologies themselves. One observer notes that teaching teachers how to surf the 'Net and expecting them to create wonderful Internet-based curricula is akin to teaching someone word processing and asking him or her to write a textbook. Experience demonstrates that using Internet in the classroom, without thoughtful preparation, structured lesson plans, a sound foundation in the content discipline, carefully-considered classroom management strategies, and detailed assessment strategies, often is a time waster for students and teachers alike.

How, then, can schools and school systems prepare their teachers and students with the capability to utilize this remarkable resource in ways not possible with traditional tools? How can teachers capture the power of this technology to engage students, to involve them in interdisciplinary explorations that stress content as well as collaboration, critical thinking, and mastery of information technology tools? And, above all, why pursue the expense and investment of time necessary to help teachers become proficient with Internet technology and integrate it into the curriculum?

Based on work at Stevens Institute of Technology over the last three years through a National Science Foundation-sponsored grant (the New Jersey Networking Infrastructure in Education project or NJNIE), it has been demonstrated that thoughtful integration into the curriculum of Internet-based resources has enormous potential to improve teaching and learning. We've taken the approach that the Internet should be considered a "value-added" classroom resource; that is, one which empowers teachers to pursue activities not possible with other tools or strategies. We contend that, where another medium will suffice, a CD-ROM, a piece of software, or even a textbook, it makes little sense for schools to undertake the expense, technical difficulty and the teacher development required to successfully use the Internet.

For example, a sixth grade class might study whales. With an Internet connection, a teacher could have students go to any number of whale web sites to look at pictures of whales, find "whale facts," and even listen to a whale song. Yet this same exploration could just as easily have been conducted using a textbook, audiocassette or CD-ROM. However, the Internet can bring a distinctive advantage, beyond these other educational tools, to this study if it is used to acquire "real time" data on where the whales migrate. Students can track, through the Journey North (Journey North, 1997) and WhaleNet (Welcome to WhaleNet, Nov. 29, 1997) web sites, the migration patterns of whales in the spring and fall and see actual daily movements of whales by plotting their position using data from satellite transponders with which the animals have been tagged. They can combine this migration data with real time data on concentrations of phytoplankton in the world's oceans which comes from the SeaWIFS project web site[1](SeaWIFS Project, 1997). Using this new data they can link the whale's migration to its feeding grounds which are indicated by high concentrations of plankton, the whale's

primary food source. All of this work can be guided by a marine biologist who may reside thousands of miles away but who can be in contact with the students using email. Clearly, these classroom experiences cannot be created using CD-ROMs, software packages, or textbooks because of the inherent static nature of these resources.

In the NJNIE project, we have observed that the Internet has a singular advantage in those explorations which can't be accomplished using traditional tools: where access to "real time" data and information enlivens the study of traditional topics (like looking up the location and magnitude of the earthquakes and volcanoes that have occurred within the last 24 hours around the world and plotting them on a map); where global collaboration with other students and content experts provide opportunities for student involvement in a real scientific exploration (like measuring the boiling point of water with students and scientists in Miami, Mexico City, and Mt. Everest and discovering how altitude affects the boiling point, or emailing a marine biologist to answer a question about seals that the teacher doesn't know); and where an interdisciplinary approach not possible with traditional tools can be facilitated by this technology (like a global water sample project in which students compare the microorganisms found in pond water in cities in New Jersey, South Africa, Japan, and England, and discover through email exchanges what life is like in those faraway places). See the NJNIE web site *http://k12science.stevens-tech.edu* for more information on these actual projects.

These projects and other unique and compelling applications of the Internet which utilize "real time" dynamic data and global collaboration to model, predict, and discover geographical and cultural differences have been the foundation of all the teacher professional development and curriculum initiatives in the NJNIE project. With $2.9 million in NSF funding and additional corporate support, NJNIE has reached 3,000 teachers from 700 schools in New Jersey. Because our partner schools see this focus on data as a compelling reason to undertake Internet connectivity and teacher professional development, we have been overwhelmed with requests from schools for workshops and collaborations.

For this reason, we sought to find opportunities for multiplier effects. Our new project, "The Alliance for Training K-12 Teachers in Instructional Technologies: A National Internet-in-Education Teacher Training Program," combines and builds upon two types of outreach programs initiated in New Jersey: partnering with community colleges to provide teacher professional development, and developing turnkey trainers or "mentor teachers" to become staff developers in their schools and districts. We see the Alliance partnership program as a viable model that can be implemented in communities in every state in the U.S*It presents a method for schools and school systems to provide wide-scale staff development in content-based applications of Internet technology and to bolster their staff development resources through collaboration with community colleges.*

The Alliance aims to provide professional development (equivalent to a 30-hour graduate course) to a minimum of 2,400 teachers in three cities over three years through a network of local organizations utilizing exemplary curriculum materials and a turnkey training approach to staff development. We believe that this model is both replicable and scaleable, and can be initiated in additional cities with local corporate and foundation support. Educational Testing Service of Princeton, NJ will evaluate the efficacy of this model and its impact on strengthening and institutionalizing partnerships between schools and community colleges as well as its impact on the extent to which teachers and students make substantive and effective use of Internet-based resources in the classroom.

The Alliance project is funded with a seed grant of $909,000 from the U.S. Department of Education over three years. Started in fall 1997, the Alliance seeks to demonstrate a "proof of concept" working with local organizations in Cleveland, OH, Miami, FL, and Phoenix, AZ. Project partners include: Stevens Institute of Technology, which has developed the curriculum materials and packaged them into 10 three-hour "hands-on" workshop modules, and which will be providing support and guidance on the workshop series, curriculum, and development of the mentor teachers; the League for Innovation in the Community College, a consortium of the country's largest and most pioneering program-oriented community colleges, which will collaborate with the three community colleges to initiate and sustain school-college collaborations; and Thirteen/WNET, the flagship station of the Public Broadcasting Network, with extensive experience in educational programming, which has provided video documentaries of classroom applications of the Internet in instruction.

The community colleges selected for this demonstration phase, Cuyahoga Community College (Tri-C) in Cleveland, Miami-Dade Community College, and Maricopa Community College in Phoenix, are all members of the League for Innovation with a strong technological infrastructure and extensive experience collaborating with their neighboring K-12 schools. In each city, different strengths and conditions exist. The Alliance program aims to build on existing collaborations and overlay a set of exemplary curriculum materials that can be adapted to local needs. The model also fosters the support mechanisms to initiate and strengthen collaborations between partner schools and community colleges.

In the fall of 1997 during the project's organizational phase, Stevens and the League met with local leadership in the three cities (including school superintendents, district-level science and technology coordinators, and staff developers, as well as community college presidents, vice presidents, faculty and other administrators). At these meetings, partners shared detailed information about

existing K-16 collaborations, current local technology and staff development initiatives, and the needs and challenges of implementing the Alliance model. In each city, a strong focus by school districts on curriculum-oriented Internet professional development combined with recertification movements have rapidly moved the Alliance model forward.

In January 1998, core teams from each city met at Stevens Institute of Technology in New Jersey for a one-week institute. This intensive institute provided a detailed orientation to the 10-part workshop series, feedback and discussion about specific local needs and adaptations, and models for ongoing support and institutionalization of these new modes of collaboration and professional development.

10-Part Workshop Series

- Introduction to the Using the Internet - Getting Online for a Reason
- Internet as a Communications Tool - Using Email in your Classroom
- Collaborative Projects - Linking up Around the World
- Real Time Adventures on the Internet
- Identifying and Integrating Compelling Web Sites into your Curriculum
- Strategies for Finding Educational Web Sites and Searching for Information
- Unique Resources for Social Science and Language Arts
- Creating a School Web Site
- Classroom Management and Training Strategies
- What Have We Learned? Final Presentations

Between January and June 1998, each community college, serving as the locus of activity for that city's initiative, will provide professional development to teams of between 20 and 40 K-12 mentor teachers. These mentor teachers will participate in 10 three-hour hands-on workshop in order to prepare to begin giving workshops in September 1998. During the fall 1998 term, the community college teams will support the mentor teachers (working in teams of two) as they provide staff development to 200-400 colleagues. In this model each team of two mentor teachers will present the 10 part course to 20 teachers. In the next cycle (spring 1999), the community college core team will reach out to another group of mentor teachers, and then support them the next term in their outreach to their colleagues. At the conclusion of this three-year project, it is expected that each city will have provided staff development equivalent to a 30-hour graduate course for a minimum of 800 teachers.

The advantages of this model are obvious: it build upon local strengths and infrastructures that already exist and provides a mechanism for institutionalizing partnerships between community colleges and K-12 schools (given the rapid rate of technological change, this is of particular appeal to schools); it builds capacity within schools by creating mentor teachers who can serve as school-wide and district-wide staff developers; it puts Internet training in the context of sound curriculum applications which have been created with practicing teachers and which are keyed to national content and technology standards; and it satisfies a variety of local needs for recertification and graduate credits for teacher professional development.

Though the benefits of this initiative are clear, the Alliance model is not without challenges. In fact, the special strengths of this model—the ability to forge new relationships between community colleges and schools, the involvement of a variety of stakeholders in planning and implementation, and the use of school-based mentor teachers to provide quality ongoing staff development—also make this a complex and formidable program to implement. Particular care has been taken to involve all the appropriate school and district-level administrators in planning meetings, and their input and feedback has been sought at every stage of implementation. Selection criteria for the community college core team and for the initial group of turnkey trainers/mentor teachers has been developed, and district administrators are choosing these representatives as much for their leadership and motivational potential as for their content background and their technological proficiency. And an ultimate measure of the success of this project will be the extent to which classroom teachers are able to and enthusiastic about using Internet-based resources in the classroom. This requires districts to support the mentor teachers and the classroom teachers as they begin implementing Internet-based lessons in their classrooms. It will require them to rethink how they evaluate teaching and learning. And it will require schools to be flexible and adaptive to the constant changes in technology and the changes that the technology catalyzes in the teaching/learning dynamic.

The success of the Alliance model rests on three complex and interdependent elements: (1) exemplary curriculum materials that present applications of the Internet that enhance, enrich, and strengthen traditional lessons and provide opportunities for problem-solving and collaboration not possible with other tools; (2) a collegial, equal, and deepening partnership between K-12 schools and teachers and community college faculty and administrators that helps schools keep pace with and plan for dynamic technological change; and (3) school system support for the mentor teachers, the professional development services they will provide, and experimentation of classroom teachers as they integrate new Internet-supported instructional technologies into their classrooms and lessons.

Much learning has gone into the development of the Alliance model. We expect much more will result from this three-year experiment to capture the best that schools, community colleges, local organizations, and project partners can pool to achieve a national imperative—helping

teachers nationwide to exploit the power that these emerging technologies can offer to enable students to achieve their potential.

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PROJECT TEAM: A COLLABORATIVE INTERNET IN-SERVICE MODEL

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The purpose of this research paper is to report on an innovative Internet based in-service model called Project TEAM - Internet (Technology in Education Advancement Model). The project was supported by the Helena Foundation and was conducted by the University of Nebraska at Omaha and the Metropolitan Omaha Education Consortium (MOEC).

The project sought to enhance the use of the Internet by involving 20 educators (with both K-12 teachers and college professors) in a comprehensive and extensive year long Internet training program. There were eight phases in the program: partnership planning, program design, participant selection, awareness level instruction, experience level instruction, classroom integration, project closure, and dissemination. This paper describes each of these eight phases and their specific role the overall structure of the project, as the project evolved from initial meetings to classroom based integration activities.

The use of information technologies in education is indeed increasing, and many institutions across the United States are beginning to plan and initiate steps to facilitate access to the "Information Superhighway," as represented currently by the Internet. In part, a vision for this effort has been identified and encouraged by the federal government. As stated by Vice President Gore, in an address to the communications industry:

> Today, we have a dream for a different kind of superhighway that can save lives, create jobs and give every American young and old, the chance for the best education available to anyone, anywhere. I challenge you....to connect all of our classrooms, all of our libraries, and all of our hospitals and clinics by the year 2000.

(National Institute of Standards and Technology, 1994, p. 57)

The "information superhighway" described by Vice President Gore, as represented by the Internet, has continued to expand commercially as well as internationally, and has now entered all aspects of our society, including K-12 education. The strong national emphasis on ensuring that our students are truly technology literate and ready for the future is continuing and has been recently reinforced by a new initiative from the federal government called "America's Technology Literacy Challenge - 1996." The initiative seeks to ensure that students will indeed have the communication, math, science, and critical thinking skills, that will allow them to thrive in the Information Age. This national mission is based on four "pillars" which include the following:

1. Provide all teachers training and support they need to help students learn through computers and the information superhighway;
2. Develop effective and engaging software and on-line learning resources as an integral part of the school curriculum;
3. Provide access to modern computers for all teachers and students;
4. Connect every school and classroom in America to the information superhighway.

Many educators at both the K-12 and college levels are beginning to show considerable interest in being a part of this effort. For education at all levels, Internet access offers the potential of "breaking down the classroom walls," and linking a classroom microcomputer with any computer on this international network.

Yet the very rapid rate of change related to the Internet is making it difficult for educators at both the K-12 and college levels to keep up and to address the training pillar of America's Technology Literacy Challenge. In particular, educators who are responsible for the technology training of

other educators are becoming aware that they are no longer knowledgeable of, and able to teach, all types and aspects of the Internet. In essence, they are finding a need to collaborate in the technology training of the Internet by relying on others for particular topics and aspects of in-service activities. There is also a recognition that training on the Internet will never truly be "completed" and the educators at their institution will need to be periodically brought up to date in new advances as they become available for classroom instruction.

Thus, along with new technologies, a new approach is emerging related to in-service training related to the Internet. This approach involves extensive collaboration between curriculum and technology specialists and institutions, to help meet the changing needs of their faculty. This paper describes a specific model for this new collaborative approach to training teachers in educational technology called Project TEAM - Internet (Technology in Education Advancement Model), which has been used successfully for an ongoing in-service project in the Omaha, Nebraska area.

A Collaborative Environment

In the metropolitan Omaha area, the College of Education at the University of Nebraska at Omaha (UNO) and the seven urban school districts have banded together to share resources, ideas, concerns, and effective practices. This cooperative approach between and among the seven urban school districts and the UNO College of Education is fairly unique in the United States. The result has been the formal establishment of the Metropolitan Omaha Educational Consortium (MOEC). The scope of the combined school districts in the Metropolitan Omaha Educational Consortium encompasses more than 82,600 students and 4,500 teachers within 155 schools.

Prior to Project - TEAM Internet, the existing collaborative structure of MOEC provided an environment for the design and delivery of two earlier Project TEAM projects which followed the in-service model described in this paper. The Dartmouth-Nebraska Partnership project, which was the first Omaha Project TEAM, was offered in 1991 and 1992. This initial Project TEAM was financed through a partnership with Dartmouth College and brought teachers from the local school districts to team with professors from the university to design curriculum packages that integrated educational technology into regular classroom instruction. Both the teachers and professors prepared curriculum materials from their respective classrooms as well as being active learners in the same workshop.

From this first project emerged a second TEAM project entitled Project TEAM - Secondary Mathematics, which was offered in 1993 and 1994 and was funded by the Helena Foundation. This project was specifically designed to provide in-service teacher education for mathematics educators. The collaborative in-service program focused upon integrating advanced educational technologies into the traditional secondary mathematics curriculum.

The success of both of the earlier TEAM projects, encouraged the development of Project TEAM - Internet, which was also supported by the Helena Foundation, and was offered during 1995 and 1996. This year long project sought to enhance the educational use of the Internet by involving a group of teachers and college professors in extensive collaborative Internet training program.

The Technology in Education Advancement Model (TEAM)

Effective teacher in-service has been identified by numerous researchers as a prerequisite to the effective integration of any technology into an educational institution (Friedman, 1991; Wood & Smellie, 1990; Jones, 1988; Crowther, 1983). Merely supplying educators with technology often does little good unless the teachers are also carefully trained to use the technology through an appropriate in-service program. However, teacher in-services need to be well planned and delivered to be successful (Boe, 1989; Hoffman, 1988; Rawitsch, 1981). A few hastily offered training sessions are usually not enough to encourage the active integration of technology into instruction. Instead, in-service programs need to be systematically planned and structured. Most importantly, in-service programs need to concentrate on gradually changing participants from technology learners to technology users and be structured to emphasize and assist ongoing curricular goals (Hubbard, 1989; Hoffman, 1988; McMeen, 1984; Moursand, 1984).

The model for collaborative in-service training in the Internet represented by Project TEAM Internet was divided into 8 distinct phases: 1) partnership planning, 2) program design, 3) participant selection, 4) Internet awareness instruction, 5) Internet experience instruction, 6) Internet classroom integration, 7) project closure, and 8) dissemination. For the institutions involved, the multiphase approach recognized that collaboration takes careful planning and time. Thus, phases 1, 2, and 3 were dedicated to the need to build a collaborative environment and structure; phases 4, 5, and 6, represented a systematic process for building expertise in the in-service participants; and phases, 7 and 8, brought the Internet in-service activities to closure and facilitated a wider range of student impact and spin-off projects through dissemination.

The eight phase model was designed to be implemented within the period of 1 year, with instruction of participants occurring during the full 12 months of the project. The eight phase approach was essential to the success of Project TEAM. Each phase is now described in more detail.

Phase 1: Partnership Planning

During the initial partnership planning phase, project partners met and discussed the collaborative potential for

the sharing of resources and expertise. A Project Director or Directors were chosen, who then worked to implement the eight phase in-service model (TEAM). A Project Evaluator was also chosen, who monitored all phases of the project. To enhance joint planning, the Project Directors worked with a planning committee comprised of master teachers, local business technology experts, and university faculty. This committee made a commitment to participate in the in-service project and provide input into the design, delivery, and evaluation of the project.

Each of the member institutions represented by the committee also contributed at least one or more topic with an instructor to the three instructional phases of the project. The actual in-service instruction was planned for delivery at the resident institution of the expert instructor, so that integration of the topic into the classroom environment could be examined more effectively. By receiving instruction from daily practitioners at the actual classroom site, in-service participants received tutelage that focused directly on classroom application and represented demonstrated success.

Phase 2: Program Design

During the program design phase, the specific in-service activities and schedule were planned. Project partners met to discuss the basic and advanced Internet related topics that would be included, as well as identify the instructors and locations for each activity. These planning sessions were usually held in conjunction with breakfast or lunch meetings and included as many of the members of the business community, master teachers, university professors, and administrators as possible. A conceptual focus to the in-service design was essential. For example, in Project TEAM - Internet the basic design of the project centered on the concept that students must be prepared to use Internet related technology to help accomplish curriculum related tasks in other disciplines (such as math, science, etc.). To accomplish the above objective, the planning group identified a schedule needed to facilitate instruction related to the curricular and technological constructs that were identified for the project. In the Project TEAM - Internet activities were spread over a twelve month period and required participants to attend the following training periods:

- Two Monday evening sessions per month
- One Saturday morning session per month
- A two day state educational technology conference
- Several Internet related field trips (school site visits, etc.)

Phase 3: Participant Selection

Participants for the in-service training were competitively selected out of a pool of applicants. To increase the number of applicants in the offerings of Project TEAM - Internet, participants were provided with several project related benefits. These benefits included a $750 stipend, $200 of hardware or software money (typically used for a modem or external hard drive), a university computer account, and 3-6 hours of university graduate credit.

Applicants were selected primarily on their potential contribution to their particular institution upon completion of the in-service training. To facilitate the selection process, and to maximize the quality of participants in the project, applicants were asked to answer questions related to the following topics:

- How training would benefit the individual applicant.
- How training would benefit the applicant's colleagues.
- How training would benefit the applicant's school.
- How training would benefit particular students in the school.

Participants were selected by a committee representing all involved in the project by a thorough review and discussion of the applications. All participating institutions had a relative number of "slots" for project participation. Representatives from each of the institutions made individual recommendations for participation, but the selection committee had the final decision as to which applicants were selected for the limited number of participation slots.

Phase 4: Awareness Level Instruction

Approximately 25% of the project instruction was devoted to "awareness level" instruction, where participants explored general possibilities of Internet application in the classroom. Awareness level activities included such overview activities as practitioner presentations, guest speakers, and general demonstrations of Internet related curriculum applications. Local vendors also could participate at this time by making group presentations related to their new Internet related products. However, sessions presented by practicing educators were the most interesting and helpful to the participants. For these sessions, it was found that it was sometimes best to meet at the school site of the presenter, to help get a solid look at how the presenter was using the Internet with students, as well as how they were dealing with particular hardware and software constraints. Such on-site visits were much richer experiences, since basic questions such as classroom organization, room configuration, networking structure, etc., were also addressed during the presentations and meetings.

The awareness level instruction served to build a fundamental knowledge in the participants as to how the Internet could be successfully used in education and sparked their interest in particular applications which were useful in their own classroom. It was found that it was helpful to keep awareness level activities as casual as possible, allowing participants to become comfortable with the project training and their ability to be successful in the project.

Phase 5: Experience Level Instruction

The second 25% of the project instruction was devoted to hands-on "experience level" instruction, where participants worked individually at an Internet accessible computer in a workshop setting. In Project TEAM - Internet, the initial focus of the experience level instruction was to help participants become competent in basic tool related applications, such as electronic mail, gopher, FTP, and the use of the World Wide Web. In addition, other more advanced topics were also included, such as authoring World Wide Web pages and working with virtual reality related (VRML) applications. Building a solid base of practical hands-on experience was essential for the participants willingness to use and incorporate the more advanced applications and it was found that the basic tool instruction should not be rushed.

We also found that instruction during the experience phase should not try to teach everything about a particular topic, such as World Wide Web page authoring, but rather enough of a topic to allow the participant to eventually explore and continue work on their own during the later integration phase of the project. Participants had the opportunity to focus on a particular application that they found useful or interesting during the integration phase of the in-service instruction.

Phase 6: Classroom Integration

The final 50% of instruction time in the project was devoted to helping participants develop a personal integration project that incorporated the Internet into classroom instruction. A significant amount of instructional time during this phase was devoted to "open lab" where instructors with special expertise in specific Internet applications were available to help individual participants with their personal projects. It was also essential to help participants build their own personal network of individuals which they could draw upon to receive technical assistance and advice. This personal network was a continuing resource that they could draw upon once the project training and support was completed.

To help build the participant's "personal network," social activities were also built into the training, such as brown bag lunches, field trips, or periodic presentations that were open to the local experts and at times the community. These social activities helped build relationships between the participants and local experts, and the participants themselves. In addition, informal talk time, such as extended breaks or lunches, were built into all the structured training sessions that allowed some informal conversation time for the general sharing of ideas and problems. It was found that this informal time among professionals was where some of the best integration ideas came from and was essential to the successful brainstorming of solutions to many technical problems as well.

Awareness and experience level activities were also offered periodically during the integration phase, to help brush up on general skills, and to continue to learn about successful applications of technology in the classroom. However, topics during the classroom integration phase primarily focused on assisting participants in developing and refining their particular classroom integration project.

It was important to note that the three instructional phases were structured to facilitate a gradual development of technical and professional expertise in the participant. During these three phases, participants moved from a general awareness of what Internet applications existed, to hands-on experience with certain tools, to a very focused integration of the Internet into their classroom instructional activities.

Phase 7: Project Closure

Following the project instructional activities each participant reported on the project they designed that integrated the Internet into the design and delivery of classroom instruction. This reporting was done through a computer aided presentation by each participant to the entire group of participants and numerous invited leaders from the local school districts. In addition, each participant prepared formal documentation on their respective project, so that the projects could be replicated for implementation in several classrooms.

During this time, the formal project evaluator viewed the presentations as part of the overall evaluation of the in-service project. This allowed the evaluator to observe the integrated Internet based curriculum projects that reflected the overall goals and objectives of the general in-service project. Further, this phase of the project allowed the project directors to report back to the planning partners initially involved with the project. The actual integrated curriculum projects and the final report from the project evaluator constituted the major components for reporting on the effectiveness of the project.

It was anticipated that the participants would expand their Internet integration activities and continue to interact with each other and the project instructors. Additional funding sources were then explored to assist in the continuation of project activities, and to facilitate replications of the project with other participants and possible spin-off projects related to the participants own integration projects.

Phase 8: Dissemination

The purpose of this final phase of the project was to share information gained in the project with a wide base of educators. First, there was considerable dissemination among participant institutions regarding individual integrated curriculum projects throughout the year long training program. In addition, in Project TEAM - Internet, each participant had access to a computer, an electronic mail account through the university, and access to receiving information from the World Wide Web. This allowed project participants to continue to share information with

the project directors, other participants, and interested professionals via the Internet system.

Traditional dissemination methods were also used. Formal papers could be submitted to professional organizations for inclusion in local, state, regional, and national meetings and manuscripts could be submitted to professional journals. Dissemination not only reported on the project's eight phases, but also on the integration projects developed by the participants themselves. Thus, dissemination included both internal and external audiences, and described individual as well as group successes as they reflected the eight phase model.

Conclusion

The eight phase collaborative in-service model, called TEAM, worked very well during the three offerings of Project TEAM in the Omaha. All the institutions involved have agreed that it was indeed more effective to approach technology in-service through a collaborative environment where resources and expertise are shared. One of the most impressive aspects of this collaborative approach was the emergence of a committed and energetic network of individuals who continued to share their expertise and collaborated beyond the two initial projects. This network of knowledgeable individuals is still a substantial resource to all initial partners in the project. Many of the individual integration products developed by the project participants were truly remarkable, and several of the local school districts even adopted individual participant projects as part of their overall school or district curriculum.

In the third Project TEAM - Internet, the training program strove to prepare these participating educators to assume a true leadership role in the effective integration the Internet into education. The project attempted to take a very practical and comprehensive approach to in-service training by involving participants in extended and well planned instruction that was carefully focused on classroom impact. It was hoped, and expected, that the Project TEAM- Internet would be an important first step for these educators in helping to locally realize the dream voiced by Vice President Gore and to initiate the training related pillar of "America's Technology Literacy Challenge."

Perhaps what was most encouraging in this project, however, was the change in the individual participants themselves. Most, if not all, of the participants are now actively helping others to integrate and learn about the Internet, and have become local experts themselves in particular Internet applications. Project TEAM seemed to have provided these participants with the technical skills and general enthusiasm to help others use the Internet confidently and effectively in the classroom. It appears that collaboration is indeed a possible key helping educators keep current with Internet related technology. In essence, we are adding additional evidence to support the old adage that sometimes all it takes for success is a little help from a friend, or in this case a "TEAM" of friends.

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Student Use of Instructors' Web Sites

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Advances in telecommunication technology and computer hardware have made access to the Internet available to more and more people (Kahn, 1997; Maddux & Johnson, 1997). One would be hard pressed to find a campus that doesn't offer students and teachers alike access to the World Wide Web (Web). This hypermedia format provides a unique opportunity for educators to create a variety of rich online learning environments (Dringus, 1995).

Many instructors are taking advantage of this popular medium and creating Web pages for their classes (Quigley, 1994; Dringus, 1995; Young, 1995; Kahn, 1997). These Web sites vary from a simple posting of the course syllabus to multiple pages that include lecture notes, homework assignments, links to other sites, interactive quizzes and password protected grade postings. The advantages of having a course Web site include reduced photocopying (which includes eliminating the expense and the handling of paper); the ability to modify the syllabus any time during the semester; and posting new and pertinent information regarding topics discussed in class. (Young, 1995; Partee, 1996; Starr, 1997) For the most part, it is relatively easy to maintain and update Web pages. (Partee, 1996; Maddux et. al., 1997)

However, the rapid proliferation of Internet resources has resulted in a great deal of useless information being posted to the world. In fact, much of what is transmitted on the Web is self-promotional or commercial. For example, Wilkinson, Bennett, and Oliver (1997) site research done by Debashis in 1995 where an analysis of 1,140 randomly selected Web sites found that 21.93% of the material was public relations and another 20.70% were advertising.

It is reasonable to assume that if students don't find useful information at their instructor's Web site, they won't use it. Accordingly, lack of use makes it difficult for a busy instructor to justify the time and effort needed to create and maintain a Web site. To make matters more complicated, the scarcity of design guidelines creates a great diversity in the quality of school Web pages (Maddux & Johnson, 1997). Both students and teachers would benefit if essential features of a useful Web site could be identified.

Purpose of the Study

The purpose of this descriptive research study was to investigate issues relating to college students' use of instructor created Web sites at the University of Nevada, Reno. The points of interest include student use of instructor Web pages and features found on a Web page perceived by students as most useful. Student use of instructor Web pages was identified by the following factors: the amount of time students report they visit their instructor's Web site, and the students' recollection of features found on their instructor's Web site.

Delimitations and Limitations of the Study

This study is confined to surveying the students at the University of Nevada, Reno. While the sample size (n = 249) is large, it is not a true random selection. The survey instrument did not control for students who had previous computer experience nor make any provisions for those students who had limited exposure to computers. The number of times students visited the instructor's Web site was self-reported and may not accurately reflect the actual time students spend at the instructor's Web page.

It should also be noted that the primary purpose of the instructors' Web sites was to provide information to their students. More precisely, the Web sites were not created to exclusively deliver instruction nor to conduct on-line courses. This delimitation is important as the complexity of Web site design and implementation for on-line instructional Web sites exceeds the scope of this research study.

Significance of the Study

The study of students' use of instructor-created Web sites is important for several reasons. First, by understanding the issues related to effective Web page design, teachers outside the subject area of computer technology could pursue the use of Web-based syllabi. Second, identifying and capitalizing on specific Web page design elements frees up time, a limited resource for instructors. Third, by identifying Web site features preferred by students, i.e., the ability to preview test questions and to see homework solutions, instructors can develop more effective Web sites for their classes.

Methods

Research Design

In this descriptive study, 12 instructors were randomly selected from five different colleges at the University of

Nevada, Reno (UNR). The instructors were identified from UNR's faculty Web page and departmental Web page. However, this was a sample of convenience. surveys were distributed only to those students whose instr ors agreed to participate in the study.

Instrumentation and Materials

The survey developed to elicit students' use of their instructor's Web site consisted of 10 items requiring yes/no, multiple choice and open-ended responses. The survey items were designed to generate students' perceptions of the Web site in terms of ease of use, aesthetic appeal, navigation problems, and usefulness of provided information. The survey was administered in paper format. The students completed the survey once for each class; however, it is possible that a student might have participated in completing the survey for different classes.

Discussion and Remarks

Surveys were distributed to ten instructors, which represented five colleges and approximately 300 students. Three instructors did not return surveys, leaving one college without representation. Table 1 shows the distribution of the returned surveys by college and department. Of the 300 distributed surveys, 249 completed surveys were returned, for an 83% response rate. Surveys were considered completed if the students answered any questions, even though some surveys appeared to be incomplete. The largest number of students participating was from the Computer Information Systems department, which accounted for 38.2% of the returned surveys.

Table 1.
Descriptive Data for College Participation.

College Department	Frequency	%
Arts & Science		
Biology	26	10.4%
Chemistry	39	15.7%
Math	20	8.0%
Business		
Computer Information Systems	95	38.2%
Education		
Counseling & Educational Psychology	9	3.6%
Curriculum & Instruction	27	10.8%
Engineering		
Computer Science	33	13.3%

Partee (1996) says that "the success of using communications technology in class depends on the swift and uniform introduction of all students to this form of interaction." That almost 86% of the surveyed students had seen their instructor's Web site is not surprising. In follow-up interviews with the instructors, everyone had made some attempt to encourage their student's use of the class Web site. One instructor posted class assignments on the Web site, requiring students to retrieve the assignments on their own. Another instructor had created an activity that not only required the students to retrieve their assignment from the Web site, but also required they do so in the computer lab and to have the lab assistant sign off that they had indeed done so. Other instructors conducted class demonstrations on how to get to the Web site and navigate its contents. Only one instructor had not required the students visit the class Web site.

Table 2 show the affirmative responses to the "Have you seen the Web site" question by department. As one would expect, all the Computer Science and a good majority (83.2%) of the Computer Information Systems students had visited their instructors' Web sites. Interestingly, the poorest visitation rate (Math, 50%) was for a Web page that offered incredibly useful and unique information. This Web site included password protected posting of grades, solutions to homework problems, interactive demonstrations of math theorems, and interactive quizzes to help prepare for classroom tests. Perhaps as a reflection of many of the Math students, one student commented "Sorry, but for the most part, the 'Web' doesn't do much for me."

Table 2.
Web Site Visits by Department.

Department	Frequency	%
Biology	24	92.3%
Chemistry	36	92.3%
Computer Information Systems	79	83.2%
Computer Science	33	100.0%
Education	32	88.9
Math	10	50.0%

More importantly, 96.3% of the students who had visited their instructor's Web site knew how to get to the Web site on their own. The assumption is supported by the fact that 70% of the students reported visiting the Web site any where between a "couple of times this semester" to several times a week. In addition, the students remembered with a fair amount of accuracy that the instructor's Web site contained the class schedule (76.6%), the instructor's office hours (76.6%), and homework assignments (69.2%). The results of all the survey questions are reported in Table 3.

Partee (1995) also said "Any student lacking access to the network labors under a real disadvantage relative to other students regarding general course policies, assignments, and lecture information." This is particularly true if the instructor does not provide this information in printed form. However, survey results show that over half of the students (53.6%) used the computer lab provided by the school to access the Web site so access to the Internet doesn't appear to be a problem. In addition, 39.1% of the students said they visited the Web site from home; all of

which supports the literature that says more and more people have access to the Internet.

The most popular items on class Web pages seemed to be the homework assignments (49.1%) and the class schedule (40.2%). While none of the students made any comments regarding the posting of the class schedule, many students had something to say about the assignments. They asked that assignments be posted "in a timely manner", at least a week before they were due, and contain information such as what is expected, due dates, and grading criteria. One student even suggested that the instructor post "an example of some prior papers." Another frequent request was for homework solutions. Some frustration must have occurred as many students commented that they needed more instruction on how to retrieve the homework assignments.

Links to other relevant sites was also a very popular feature (34.6%) and rated the third top feature for improving the Web site. One student commented, "I think his Web site is extremely useful; especially the links he enables us access to at other relevant sites." Only two students commented on links that didn't go anywhere. Table 4 shows a selected sample of other student comments.

Lecture notes was another popular item (23.3%). Some of the comments included "explanations of lectures", "more concise groupings of topics", and to "put the lecture notes out earlier, not the day of class." More importantly, lecture notes was the item that most students selected (26.2%) as feature that would make the Web site more useful.

There did not appear to be any problems with the appearance of the instructors' Web pages as there were no specific comments regarding this issue. The students recalled that they contained graphics (58.4%) and a variety of colors (52.3%). These features also ranked high in both the most liked and the least liked features. Moreover, these were not features that could be improved upon to make the Web site more useful. However, many students commented that they didn't like waiting for graphics to download. The least liked feature was sound (21.0%).

Construction of the Web pages didn't seem to be problem either. Most of the students (73.8%) responded that they were able to navigate to and from information links with relative ease and convenience. Most of the comments suggested the problem was the students' a lack of experience and knowledge in how to use the Web browser. Another frequent complaint was the amount of time the server was down, thus preventing the students from even getting to the Web site.

In summary, students are using the class Web sites created by their instructors and they are doing so from either the schools computer lab or home. While many are frustrated by their lack of experience with using Web browser, overall they understand its potential usefulness. To make the most of class Web site, instructors should require students to use the Web site very early in the class and perhaps not provide printed copies of information that they have posted. In construction of the Web page, graphics and sound should be used appropriately, as students don't like to feel their time is being wasted on "frilly" extras. Lecture notes and homework solutions are the two features students determined would make the Web sites more useful.

While Dringus (1995) was primarily concerned with on-line courses, her recommendation that instructors conduct a usability evaluation is still applicable to course Web sites. This can be done as a survey to a sample of students during the design phase, as the course evolves, or at the end of an academic term. The results should assist the instructor in determining design improvements for the course Web site.

Implications for Further Research

The responses recorded in this study support the finding of many other researchers regarding student and teacher use of the Internet. That is, instructors are increasingly taking advantage of the resources made available through the Internet and are finding an interest in creating Web sites for their classes. Also, students as a whole seem willing and able to use instructor created Web sites. However, actual usage by students still seems elusive. As this could be attributable to a variety of factors, this survey should be conducted again with a larger and more randomized sample. Further experiments could be done to determine specifically how students are using their instructors' Web, i.e., only for assignment retrieval, homework solutions, or lecture notes. Other items that might be explored concern the appearance of the Web pages such as screen layout, color, navigation options, and feedback options.

Table 3.
Responses to the Survey.

Item	Frequency	Percent
1. Have you seen the Web site?		
Yes	214	85.9%
No	35	14.1%
2. Do you know how to get to the Web site?		
Yes	207	96.3%
No	8	3.7%
3. How many times have you visited the Web site outside of class?		
Haven't yet	24	11.1%
Once	43	19.8
A couple of times this semester	68	31.3%
Once or twice a week	48	22.1%
Several times a week	34	15.7%
4. Most of the time how do you access the Web site?		
Computer lab	118	53.6%
Work	10	4.6%
Home	86	39.1%
Other	6	2.7%

5.	*Which of the following features are available at the Web site?*		
	Graphics	125	58.4%
	Variety of color	113	52.3%
	Sound	26	12.2%
	Animation	28	13.1%
	Lecture notes	73	34.1%
	Homework assignments	148	69.2%
	Class schedule	164	76.6%
	Instructor's office hours	164	76.6%
	Links to other relevant sites	105	49.1%
	Other	21	9.8%
6a.	*What do you like most about the Web site?*		
	The colors	44	20.6%
	The sounds	13	6.1%
	The graphics	50	23.3%
	The animation	18	8.4%
	The lecture notes	63	29.4%
	The class schedule	86	40.2%
	The homework assignments	105	49.1%
	The links to other relevant sites	74	34.6%
	Other	15	7.0%
6b.	*What do you like least about the Web site?*		
	The colors	37	17.2%
	The sounds	45	21.0%
	The graphics	28	13.1%
	The animation	35	16.4%
	The lecture notes	19	8.9%
	The class schedule	11	5.1%
	The homework assignments	15	7.0%
	The links to other relevant sites	12	5.6%
	Other	17	7.9%
	Are you able to navigate to and from information links with relative ease and convenience?		
	Yes	158	73.8%
	No	31	14.5%
9.	*What would make the Web site more useful to you?*		
	Don't have an opinion because I've gotten by without it	41	19.2%
	Better graphics	14	6.5%
	Different colors	11	5.1%
	Animation	9	4.2%
	Sound	9	4.2%
	Lecture notes	56	26.2%
	Class schedule	10	4.7%
	Homework assignments	19	8.9%
	Instructor's office hours	7	3.3%
	The links to other relevant sites	22	10.3%
	Other	34	15.9%

Table 4.
Students' (S) Selected Responses to Survey Question 10:

"In what other ways could the Web site be improved."

S14: The titles in the homework should match the titles in the book.
S49: Smaller fonts.
S54: Reduce size of page – too much scrolling!
S75: Make it more mandatory in the curriculum of the class. Maybe if we were required to use the Web site in order to access certain material pertinent to class.
S85: It's for a class and because of time constraints there should be less graphics. All I want when I go to the site is the written material I can print for reference!!
S108: Graphics, animation, homework assignments dated on a more timely basis. An example of some prior papers.
S110: Better display - clear presentation of assignment and due dates. Whether assignments need to be handed in etc.
S122: Make it clearer as to how the student accesses other informative links and sites.
S132: Clearer access instructions
S138: By giving students practice quizzes or tests to focus on main points of lecture.
S147: Because I use it for school and time is limited I would like less graphics for faster download times.
S168: Since it is a computer class, it should showcase technology, i.e., graphics, colors etc.
S223: With a new picture.
S233: Put notes and homework.

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GRADUATES AND UNDERGRADUATES—MEETING ONLINE

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Technology integration — growing numbers of educators are suggesting that this should be the role of technology in today's educational system. Computers, at the heart of this technology, should no longer be used as dust-catchers in the corner, or merely as rewards for those students who finish assignments early. They should be more than electronic workbooks or electronic flash cards where traditional educational activities are simply transferred into digital format. Key t this issue, though, is whether teachers have the skills, knowledge, time, and access to allow them to partially or fully integrate technology into their classes.

Technology standards and competencies are being developed to identify specific skills and issues that will facilitate this technology integration throughout the educational arena. The most well-known set of standards has been prepared under the sponsorship of ISTE (the International Society for Technology in Education), and is available both in print (Weibe & Taylor, 1997) and online (ISTE, 1997). Technology competencies are being compiled by a variety of bodies at various levels in the educational system. One of the more extensive listings of technology skills and knowledge is the North Carolina Competencies for Educators (1997), which is available online. With this growing attention to the use of technology within today's schools, it is essential that educators be prepared to integrate this into their classroom learning environments.

Where do teachers learn about this technology? How do we prepare the teachers of today and tomorrow to use technology as an integral tool in their classrooms, as well as in educational endeavors outside the classroom and for professional development?

Colleges of Education are in a unique position to assist with the development of technology skills and knowledge for both preservice teachers, and those who are already teaching. Preservice teachers are often are often required to take one or more technology courses, and there is a definite move to integrate technology into instruction throughout the content and field-based courses. Teachers who come back to school as graduate students may elect to take educational technology classes (or entire degrees), or they may find that they are using or seeing modeled some of the newer technologies, in the course of their studies.

Rationale

Schools have been acquiring *technology*, often in the form of computer hardware and software, but many teachers are not using these effectively or at all to enhance the learning environment of their students. Currently a primary addition to many schools and classrooms is Internet access, along with the related computers, if needed. Will this, too, go the way of many advances—where only some teachers use them, and not all of these do so appropriately?

Teacher education offers one approach to preparing current and future teachers to effectively use technology in their classes. Undergraduate students (preservice teachers) can see the appropriate use of technology modeled, can use it in their university classes, and can also be expected to use these techniques in their K-12 classroom teaching assignments. These students need a broad base of skills, especially since they do not know where they will be working.

Colleges of Education also work with current teachers—graduate students enrolled in degree or additional certification programs. These individuals are looking for ideas to implement in their classrooms, and may be able to get specific technologies for use in their rooms. They come with specific needs and desires, but are often open to suggestions of new approaches, including those involving technology. Currently, the greatest interest is in the use of the Internet to expand the classroom, and to enhance instruction. Teachers have heard that this is possible, but they may not have any idea of what it means.

One Approach

Colleges of Education include both undergraduate and graduate students, both preservice and current teachers—either on their own, or in conjunction with other institutions. This provides them with a unique opportunity, to have both groups work together, sharing their expertise, and gaining new perspectives about the use of technology in the schools. Opportunities for *real-world* experiences related to current professional activities, for mentoring/networking, for the

development of a sense of professionalism, and for on-going personal and professional development abound.

The authors, College of Education faculty members — two working with preservice teachers, and the other with graduate students who are K-12 teachers, have made a commitment to provide students with experiences that will contribute to the development of these ideals. They have worked together to provide students at both levels with appropriate experiences related to each specific course, that will also promote the ideas of networking and sense of professionalism and professional development that will provide educators with tools to use to enhance both their professional and personal lives. Students have found and used Internet resources (including lesson plans), 'published' lesson plans and other resources on the web, and participated in virtual teaming activities. They have interacted with students from their same, as well as different semesters, through the information that has been published on the web.

The Classes

The undergraduate students are in the final year of their preservice program, enrolled in either the intern (in the schools 2 days a week, and in class weekly) or the resident (in the schools full-time, with seminars every other week) semester. Prior to these classes, students have completed a basic computer literacy course (not part of the professional course sequence, as well as an educational technology course (with an emphasis on integrating technology into instruction). Students (other than transfers) already have their university Internet accounts, and have used e-mail and the web in both technology courses. The major stumbling block at this point is the lack of Internet access in the schools where students are serving as interns and residents — although the schools may have Internet access, they are not always open to these students using the Internet from their campuses.

The graduate students, during Fall '97, were enrolled in a special topics class (ETEC597), within the Educational Technology (ETEC) program. The course was titled for the text that was being used — Knapp & Glenn's (1996) *Restructuring Schools with* Technology. All students (except one) were either teachers or administrators in public or private schools. The one exception has experience with Upward Bound, and is completing certification—in her communications during the course, she fit right in with the other educators, and her lack of classroom experience was rarely evident.

The Graduate Course

In Fall, '96, two of the instructors attended a distance education training workshop. As a result, they were able to apply for (and received) a grant to hire a graduate assistant to help with online course development. The course to be designed was a graduate course which would provide support for preservice teachers in secondary education. The graduate assistant, who had successfully completed both the intern and resident semesters as an undergrad, was able to provide valuable input about how the graduate and undergraduate programs could support each other, and worked well as a team member, with the two faculty members.

The course was offered in Fall 97, in an online format, with fourteen students examining ways to use technology as a tool in the classroom. One of the grad students was a Graduate Teaching Assistant, working with the preservice teachers, and she described the undergrad program (the intern and resident semesters) to her classmates, and was available to answer questions throughout the semester. Having her in the class was a great assistance, in helping the graduate students understand the undergrad program, which had changed dramatically from when they had done their student teaching.

To further prepare the graduate students to work with the preservice teachers, the students were asked to submit reflections on what they would share with preservice teachers (PT's), based on the weekly readings, discussions, or experiences. Meanwhile, the (PT's) were using e-mail and the web for communication and information seeking and retrieval. They were also reviewing and critiquing resource pages prepared by previous graduate classes. The critiques were thoughtful, offering valid suggestions, and they were encouraged to share their comments with the original page creators.

Virtual Teams

After midterm, Virtual Teams were formed. For these, students were divided into seven groups, with an average of six people (divided evenly among grad, interns, and residents) per group. Students exchanged introductions, with the graduates describing what they considered to be the role of technology in the schools, sharing specific instances of their use of technology , and asking for input. Despite some technical and other problems (server down, no access in some schools, mis-addressed mail that was returned, etc.), there were some quite valuable (and interesting) exchanges

A sample dialog, centered on one graduate student and her communications with preservice teachers, demonstrates the foundations in networking and professional activity that are among the goals of the program. In the following, *GRAD* indicates the graduate student, an elementary teacher, and the Preservice teachers are indicated by *Pre1*, *Pre2*, etc.

GRAD:

> Dr. E. has great plans for you'll. 597 has an assignment to search the net and find "the site" we think would help you the most when you begin teaching. This will be added to a list that has already been started. There are so many great sites with truckloads of information it would be helpful if we knew the grade and subject you plan to teach so that the site we pick for you would be most beneficial.

Thanks.

After students sent her their information, she replied:

GRAD:

Pre1, Thanks for responding to my e-mail. :-)

I have asked the band teacher at my school to bring me her list of sites that she thinks she has in an educational music organization mag. I will send these to you as soon as I get them and I will surf as well. If nothing else, we should be able to find music types from different countries. This would add a cultural flair.

The band teacher said that many instruments have web pages. She may be getting web pages and newsgroups mixed up; but, either should work for you.

Wish me luck.

GRAD:

Pre2, I was searching the net for technology standards and found this site I thought you might be interested in: http://www.etc.bc.ca/lists/nuggets/english.html

GRAD:

Pre1, Today I have been looking for technology standards(another assignment)and found a site that I think you might like: http://www.etc.bc.ca/lists/nuggets/art_mus.html

There are many music links.

Pre1:

Wow, I checked that site out and it was incredible. I was only able to look at a couple links but have it bookmarked for future reference. That was exactly what I was looking for.

Thanks

Other comments reflected agreement with the original sender, and by reading about and replying to messages describing successful technology use in the classroom, we hope that our preservice teachers will become technology-integrating teachers in their own classrooms, willing to request (and hopefully expecting to find) appropriate technologies available for their use on a daily basis. The following response from one of the undergrads (and similar comments from other students) will hopefully be indicative of that outlook when these students begin their own teaching careers.

I enjoyed your information regarding technology in the classroom. I agree that it is important and relevant. I believe that it will be a necessary tool to implement in all classrooms in the future.

The graduate students were all champions of the value of using technology to promote learning in the classroom, and their enthusiasm was often contagious. The following is from a preservice teacher is amazed at what the grad student is able to do with old computers, and who obviously appreciates and agrees with the grad students positive outlook about the values of integrating technology into the classroom.

I think it is amazing how much you are able to accomplish on your 286s. You sound like someone is really excited about technology and will be ready to use the new technology at the new building. I am a student teacher at a new school, and the technology at this school is outstanding. There are two computer labs, one for each grade, and each teacher has his or her own computer.

The Future

As we await the final student reaction to the project, we are already planning for next semester. The graduate course will be different (Computer Assisted Instruction), and some of the residents will have participated as interns this semester. We will include student activities that relate to various other classes, where grad and undergrad students can use and respond to resources that our previous students have created. Some students from this fall have already mentioned wanting to keep in touch with other members their Virtual Teams, and we will be watching this. In addition, to facilitate this as well as other joint interaction, we will be setting up conference and chat space where current and former students can meet and maybe even collaborate on projects.

Summary

The opportunity for graduate and undergraduate students to work together provides all involved with a broader perspective on ways (and reasons) to integrated technology, as a tool, into the schools. As students networked, they acquired and enhanced skills that will promote their professional development in ways specific to their needs now and/or in the future. Virtual teaming promoted personal and professional exchanges in which students shared experiences and visions for the integration of technology into a variety of educational situations.

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Helping Teachers Teach Better: Reinforcement of K-12 Content Instruction through Web-Based Instruction

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Educators throughout the nation are challenged and frequently frustrated in our efforts to deliver on the great promises of technology to the improvement of education. This situation is particularly true among Alabama K-12 teachers. Although the number of computers in Alabama K-12 schools and postsecondary institutions is proliferating, computer-managed instruction (CMI) and computer-assisted instruction (CAI) have not been an integral part of the general curriculum. Studies have found that the only personal attribute that was a consistent predictor of technology adoption was the technological orientation of the instructor's discipline (Hirschbuhl & Faseyitan, 1994; Lan, 1993). For teachers who use technology, frustrations are many. One of them is that they haven't been provided with sufficient training and support for the use of computers in their disciplines. For those who do not use technology, as well as for many who do, a vision of what the technology is bringing into the teaching profession is yet to be created, much less realized.

To realize the vision of bringing technology to our classrooms, technology resources, training and support are needed. Professional development efforts are needed to provide training for practicing teachers in the utilization of subject-specific software to access resources which are available on the Internet in the subject areas of the core curriculum. Teachers require the basic skills to use technology to achieve the vision of teaching professions in the 21st century.

The absence of technology integrated programs and curricula indicate that the schools are not preparing students adequately for the 21st century workforce. This is particularly true in schools where resources are meager, and students are often under prepared. In a meeting of the UAB School of Education (SOE) Dean's Board of Advisors, members of the business community, when asked to describe their concerns regarding the status of education for students in the State of Alabama, stated that greater availability and skills to use technology are necessary for all students.

Since the ability to use technology will be a prerequisite for workers of the 21st century, the Dean's Advisory Committee expressed the belief that it is essential that schools prepare students to be users and consumers of technology, and that up-to-date equipment, including sophisticated use of the Internet, should be expected in all Alabama schools. Programs must be available for the training of teachers to assist them in use of these technologies in the classroom. To that end, adequate budget support for ongoing training in cutting edge technology for teachers must be established.

Education reform can be more successful through a partnership between the university and the community. Previous studies have indicated that collaboration between higher education institutions and K-12 schools brought two related paradigm shifts — structural and instructional. Instructional shifts include teaching and learning, ways of organizing teaching and learning, school and community interaction, and outcomes of schooling. In each of these categories, technology plays a vital role (Fountain, 1993). The Internet/Web-based instruction has drawn more and more attention from educators in both higher education and K-12 schools. Web-based instruction provides students and teachers with the opportunity to be engaged in dynamic instruction as well as providing opportunities for user integration of already developed Web-based instructional components. The use of computer technologies seems to hold the potential to make education more responsive to the needs of under prepared youth by fostering competence built upon unique cultural resources and individual skills already possessed (Thomas, 1992). This is particularly promising for Alabama students given the demographic and economic composition of the population.

By virtue of its faculty and resources, the UAB School of Education has considerable potential to provide outreach services, technical assistance and training, and thereby, to serve its area, region, and State as a leader of educational reform and the integration of technology into the schools and the community. The importance of taking advantages of available technology in in-service teacher education is recognized by the leadership of higher education institutions and at the K-12 schools. However, although hardware

(computers) are present in most Alabama K-12 schools, and the UAB SOE has computer labs for students and provides computers for its faculty, faculty/teachers knowledge and skills to use technology and discipline-specific instructional software to enhance teaching and learning in the core curricula have too often been lacking.

Overview of the Web-based Instruction Project

Through the funding of a Dwight Eisenhower Grant, the School of Education of University of Alabama at Birmingham (UAB) is implementing a five-year Web-based Instruction for K-12 Teachers Project to provide training opportunities to selected teachers from the State of Alabama.

The purpose of this project is to provide statewide across-the-curriculum professional development opportunities for teachers in Alabama K-12 schools to enhance their teaching effectiveness specifically as it relates to the Alabama Courses of Study guidelines applicable to subject areas through incorporating current (existing) and state-of-the-art (emerging) instructional technologies.

The project was initiated at the end of 1996. The middle school was chosen for the first year of the project because the middle school concept is new to Alabama teachers. Until recently, Alabama middle school teachers were prepared in either elementary or high school programs. With 4x4 requirements and the new middle school graduation exam, substantive learning must begin in middle schools.

In the second year of the project, the training will focus on using web resources to facilitate the instruction of high school core curricula. Web-based instruction for elementary curricula will be the focus of training workshops in the third year. In the fourth and fifth years of the project, training will be provided for school administrators and librarians/media specialists.

It is anticipated that after the five years envisaged for this project's implementation, UAB will continue to build a cadre of technology oriented K-12 teachers who will carry out, using the training curricula and format developed through this project and field-tested to prove its success, the task of preparing more technology savvy teachers who in turn will lead and train their colleagues in their respective school districts.

Project Activities

Summer Workshop

The design of the summer workshop curriculum took into consideration the discipline-specific needs of the participants. It focused on Web-based teaching resources and techniques since research not only has pointed to Web-based instruction as one of the main trends in the future of education, but also suggests many advantages for student learning.

The curriculum development process included consultation with curriculum specialists, and collaboration with UAB Schools of Business, Medicine, Arts and Humanities, Natural Sciences and Mathematics, and Social Behavioral Sciences, where necessary.

During the first-year program, 37 teachers from 22 schools located in 13 counties participated in two one-week long summer workshops at the UAB School of Education computer laboratories. The curriculum of the workshops was planned to be both hands-on and guided by instruction. Workshop activities were designed to improve teaching effectiveness and to increase productivity through incorporation of computer and other information technologies in specific subject areas in which participants are teaching.

The following is an outline of the activities of the five-day workshop:

Day 1 - Web-based Instruction - Getting Started:
- E-mail setup
- Retrieving information on the Internet
- Communicating with others on the Internet

Day 2 - Web-based Instruction - Beyond the Classroom:
- Desk-top conferencing - CU-SeeMe
- Distance learning
- Video digitizing - QuickCam

Day 3 - Web-based Instruction - Build Your Own Site:
- Internet publishing
- Web page construction

Day 4 - Web-based Instruction - Curriculum Integration:
- Curriculum integration
- Web Whacker and Zip Drive
- Cultural pluralism

Day 5 - Web-based Instruction - For Those with Special Needs:
- Adaptive and assistive technologies
- Government policies and databases

Follow-Up Activities

In order to ensure that the participants continue to use the skills learned in the summer workshop to enhance their teaching and to benefit their students' learning, it was critical that the participants be provided with on-going personal assistance by project staff. In order to reach that goal, it was necessary to build a rapport between the instructors and the participants based on continuous, timely, and meaningful interaction. Several strategies were developed to facilitate the process.

1. "Tele-Mentoring". A "tele-mentoring" system was developed and used to provide personal interaction and assistance to all participants in the project. Several project personnel served as "tele-mentors"; each "mentor" assumed responsibility for 4-5 participants as "tele-mentees".

   The responsibility for "tele-mentors" included:

- Periodically (e.g., at least every two weeks) send messages to "mentees" about new developments in technology, new practices in the field, and new applications available, etc.
- Ask "mentees" to share what they have been practicing in the class using what they learned from the workshop
- Provide consulting and advice as problems are identified
- Encourage the sharing of practices and problems among participants and with project staff directly or through the project Web-page

Exemplary practices are displayed on-line on the project Web-page as examples for next cycle of project. Problems are collected and summarized, so that as we plan for the next cycle, we will be able to anticipate problems and deal with them ahead of the time.

2. Site Visits. Site visits were made either in group sessions at schools and ASPIRE Regional Training Centers, or at participants' individual schools. Site visits were made by both the project director and the project evaluator.

The activities for site visits include:

- Observe classes using web-based instruction, e.g., WebWhacker, CU-SeeMe, e-mail, etc.
- Interview students in class about their experience with technology
- Assist participants with application and technical problems
- Take pictures and videotape class activities

During site visits, project participants were asked to:

- Share with the project director problems encountered
- Share with the project director improvements in student learning
- Share with the project director student portfolios related to the use of Web-based instruction in class (e.g., on-line and cooperative research projects; on-line correspondence with scientists, educators, and other students outside of the school; on-line publishing; on-line database creation; virtual field trips; on-line social action projects; etc.)
- Share student portfolios they collected

3. "Mini-Retreat". As part of the continuous reinforcement of skills for Web-based instruction, a "mini-retreat" is planned in the winter of 1997. This will provide an opportunity to bring all project staff and participants together. It will be a working session as well as a "show time" for all participants.

During the summer institute, participants learned to search the Internet to find already developed instructional tools and resources. They also learned to use WebWhacker software to download Web-based information to a diskette for use in classrooms not connected to the Internet. Alabama SDE is planning connectivity for all schools. However, it will not result in connectivity for all classrooms. Thus, the use of WebWhacker will allow teachers the advantage of using Web-based instruction without having to be connected to the Internet. Other advantages to teachers include no waiting time for information to be transmitted on-line, eliminating inappropriate sites, and more easily keeping students on task. A second skill obtained by participants was that of video conferencing using CU-SeeMe with cameras and the Internet.

Participation Guidelines and Incentives

Participation guidelines were included in the initial Web-Based Instruction Project announcement to schools with criteria for participants' selection and suggestions for participating schools. It was suggested that schools select highly motivated teachers whose teaching field was related to the Alabama Courses of Study applicable to the subject areas, and that they send at least two teachers from each school so they could reinforce each other's efforts in using technology and help others in the school benefit from their experience. It was suggested that schools provide professional development credits and other incentives for teachers mastering technology goals. Selection priority was given to applicants who were in a qualified minority group, or teaching in economically disadvantaged or rural areas.

Some of the software and peripherals purchased through the project were available for participants to take back to their schools (e.g., WebWhacker, the Internet Camera, Zip drive) so that they could continue to reinforce the skills they learned in the workshop.

The Commitment of the Participants

The schools/school districts and individual teachers throughout the State have provided strong support to the project since the beginning. After the project was announced in May 1997, we received more than 80 applications from middle school teachers throughout the State. In June 1997, project director Dr. JoAnn Lan made a presentation about the project at the Alabama Educational Technology Conference (AETC) at Birmingham-Jefferson Civic Center. Another 40 middle school teachers signed up for the workshop at the conference. Unfortunately, due to the number of computers available in UAB SOE's computer lab, and because the nature of technology training requires intensive teacher attention to students, and we wanted to provide the best experience possible for our participants, we determine that workshop size would not exceed 20; this resulted in 40 summer workshop participants in 1997.

The large number of applications received is evidence of strong interest and urgent need for the project. In order to keep the workshop size manageable, we have developed clear selection criteria which provide congruence between the project participation and the national objectives of the Dwight D. Eisenhower Grant. For example, selection priority will continue to be given to teachers who 1) teach in

core curricula area (math, science, social studies, and language arts, 2) from schools that are located in traditionally minority, economically disadvantaged, or rural areas. These criteria clearly demonstrate our intent to keep in alignment with the applicable Alabama Course of Study, and to provide service to the under represented population.

The commitment of the participants is evident also in their contribution of their personal resource of $1,000.00 to upgrade the Internet camera. Through the grant, the participants were provided with an Internet camera as an instructional tool. Ten participants contributed $100.00 each to upgrade the camera from Black/White to color.

Evaluation of the Project

An external evaluator was contracted to conduct the evaluation of the project. Evaluation of the project indicated that only approximately 25% of the participants had used an e-mail account or WWW prior to attending the summer workshops. However, many participants had or have had a computer in their rooms. The lack of both Internet experience and connectivity in schools provides evidence that this project is meeting an urgent need both in training Alabama school teachers and in using existing hardware to provide Web-based instruction (via Web Whacker).

The initial evaluation of the summer workshops was very positive. Content analysis are being used to analyze the "Tele-mentoring" component with the goal of finding "themes" in the communications between mentors and mentees. Use of the "themes" can provide information for program improvement and planning.

During site visits made by both the project director and project evaluator, field notes describing both accomplishments and problems were collected. Data from student interviews are being analyzed using qualitative methodology. A report describing the evaluation data obtained from the classroom will be provided to the project director by the project evaluator at the end of 1997.

Continuation of the Project

Following the first-year summer workshops and during the site visits, we have received many requests from project participants to provide advanced training opportunities. It is apparent to the project staff that teachers not only see the need for technology training, but also are highly motivated to learn more about Web-based instruction and computing technology applicable to their specific fields. To meet this need, beginning in the second year, advanced programs will be offered to bring interested first-year participants back for a 2-_ day workshop for knowledge and skill reinforcement training. Included in these sessions will be training for participants who will become trainers in their geographic areas.

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Blazing the Frontier Trails of Distance Teacher Education

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Alternative teaching methods and delivery systems have become a focus of educational programs. Massy & Zemsky (1995) observed two trends emerging with distance learning. The first trend is the new demand for information technology-based teaching and learning, and its substantial growth in the next decade particularly as an economical means of providing more readily accessible post-secondary education and credentialing. The second trend is the profound change in teaching and learning. Institutions can reap the benefits of the great potential that distance learning offers if they transform themselves in fundamental ways.

Whether or not one agrees that today's colleges and universities have a worthwhile core of values that should be protected or that technology should be in part substitute for faculty labor, the potential for increased learning productivity through technology is too great for higher education to ignore. If colleges and universities fail to adapt effectively, other kinds of institutions will take up the challenge. (Massy and Zemsky, p. 11)

We need to not only make teachers aware of the latest technologies, but how we can learn through them and implement them into our classes (Milet, 1996). Viau (1994) stated that minds of tomorrow must be open and able to deal with information that is always changing and increasing. Educators must realize that tomorrow is here today with respect to developing innovative teaching techniques for keeping up with informational changes.

Marketing Strategies for Distance Learning Courses

Marketing strategies are extremely important in the development and implementation of distance learning courses. Since distance learning courses require a great deal of advanced planning and authoring on a website, costs in terms of time and technological applications are high and possibly wasted if enrollments do not materialized. Marketing is a topic that is not talked about much in distance learning yet plays such an important part in the success of your program. In developing our first distance learning courses, we discovered various things to do and not to do in marketing and publicizing our course offerings.

Define your population. Is there a certain professional group you are designing your course or curriculum for? Possibly this group as a whole participates in certain conferences or belongs to the same organizations. This knowledge helps in getting names and addresses from membership rosters. A list of previous on-site course enrollees is another example of potential students.

Determine the awareness, needs and technology available of your population. Is your population aware of what a distance learning course is? Do these professionals need certain courses for certification or for the performance of their responsibilities? What technologies are available to them for taking the course and how comfortable are they in using them? Recently, we administered a survey to 200 professionals at a conference in our discipline. We discovered that they had very little knowledge of what a distance learning course was yet they wanted to know more about it, their schools/agencies were requiring more use of computer technology in their curriculums and administration of duties, and that certain training topics were being endorsed by the state credentialing agencies. Obviously, this information was invaluable in designing brochures, courses, and technologies for our offerings.

Website and hard copy information sources. Even though accessing websites for information is usually very easy for the technology literate, additionai hard copies tend to reach more individuals and reassure others considering the move to using technology in taking a distance learning course or who may not have current access to the internet.

Designate a contact person. Being able to contact someone who is knowledgeable and part of the course, is an important asset for answering everything from course requirements to what kinds of technical skills are needed for just being in the course.

Use listservs. Professionals into the use of computer technology invariably get involved in listservs which address their disciplines and professional interests. Listservs contain a ready made audience of potential enrollees.

Conference presentations and exhibits. Presentations and exhibits allow you to show the technology involved and the potential of delivering pertinent information to professionals in a distance learning manner. Also, they create question and answer opportunities for those desiring more information.

Support systems. The delivery of a course is only as good as the systems creating it. Cooperative efforts with various departments such as instructional technology, continuing education, and the course discipline involved are necessary to not only carry off the course itself but to publicize it in the most effective means available. Our instructional technology unit showed us the strengths and weaknesses of different technologies in delivering course materials while continuing education related how to make mailings and material distributions more effective.

Marketing is more than just bulk mailing. Consult with individuals who are knowledgeable in the promotion of products. Journal advertisements and stories involving your programs create publicity as well as personal contacts with professionals. Former students are an excellent source through word of mouth to other professionals. Always inform students toward the end of a distance learning class about upcoming course offerings.

Do not rely on others to promote it. Other professionals and support people do not have the vested interest in this course you do. With the time and energy you are expending to put this course together, it is only natural that you would want to self-promote this course as an important offering.

Avoid being an elitist. There is no such thing as a trivial question involving distance learning. This is a new way of course taking and thinking for many individuals. There will be lots of questions before the course ever starts and during the course on everything from what's the internet to how do I find the course site to what do you mean by downloading, etc? The time, simplicity, and patience you take in answering these questions will directly correlate with who enrolls now and for later courses.

Start early. We discovered the planning and developing of a distance learning course takes somewhere between six months to a year, surveying and marketing are a must in determining if the course offering was worth the time and energy to produce let alone assure the minimum enrollments to actually conduct it.

Student Responses

In considering the World Wide Web as a teaching and learning environment, ongoing student responses are a critical tool in fine tuning a distance learning course. According to the student responses to our courses, we have compiled a series of concerns that should be addressed in planning and conducting a distance learning course.

In the asynchronous virtual classroom, students and instructors come and go at all times. The attractiveness of distance learning lies in the fact that students do not have to be at a certain place at a certain time is described as asynchronous learning. Many students with hectic professional/personal schedules such as family obligations, as well as students who are not within easy driving distance find distance learning a very attractive alternative to the traditional classroom learning environment. Scheduling problems are circumvented by allowing students to make choices as to where and when they study and participate in class. This approach can be a disadvantage to some students. Asynchronous learning may not be for everyone, at least not initially. Some students are synchronous learners. They enjoy the atmosphere and learn best in the traditional classroom with regular meeting times and an instructor leading class discussions. With the freedom that technology provides, it becomes very easy to put off study. Our distance learning students indicated a high degree of time management skills are needed for a successful distance learner. Overall, assignment deadlines were very helpful to students in managing their time.

The teacher's role is changing in education. We are evolving from the teacher being an "authoritative figure" to the teacher becoming a "guide by the side." Thanks to the informational technology age and a wealth of information at hand, it has become increasingly more important to be able to find information as opposed to "knowing it all." Computer mediated instruction makes the student more responsible for self-learning, with the on-line student being guided by the instructor with more responsibility in finding his or her own way. Sharing technical skills and information websites with students motivates their use of online educational pursuits. This makes distance learning courses very attractive to teachers enhancing their knowledge or skills.

Another factor to consider is whether a course is cohort-based (taken with a group of students) or self-paced (open entry and open exit). Cohort-based courses have scheduled beginnings and endings with specific assignment time windows for forums. An assignment time window may be a ten day period in which students respond and discuss a topic. At the end of the ten day period a new forum assignment is given. While the old assignment is still accessible, it is no longer the current topic in focus. A Web-based discussion forum allows students to interact with fellow students as well as the instructor and become a virtual classroom. Students have noted that Web-based discussions can lead to more participation in class with discussion requirements for all students. Therefore, all students receive a chance to speak and the wide range of experiences, job responsibilities and various geographical locations seem to enhance the discussion forums.

The process for beginning a distance learning class includes a learning curve. The size of the curve may depend upon the technology background of the individual. Many students may initially feel uncomfortable with the technological processes being utilized. A two week period to get

everybody "up and running" is recommended. Many students make comments such as, "I am getting an internet connection", or "I am getting a computer"; however, the process may actually take longer than expected. Using a variety of technological methods such as World Wide Web, e-mail, discussion forums, computer software, etc., create various responses from the learner. The more user friendly the technology, the less difficulty our students had in participating in course activities. Using a "one site does all" is recommended over the use of multiple software programs. The fact the World Wide Web is standardized allows instructors to place information on the World Wide Web for easier access and fewer problems. When students are "up and running" instructors can get to the "meat of the course" and focus on content-rich lessons.

Not only is the information more easily accessible to the student in a distance learning course, the necessity of clear and precise instructions are critical to student comprehension and performance of course activities. This makes creating online content the most difficult part of developing a viable web-based course. It is not simply a process of translating your basic lecture notes to the web. Information posted on the class website should be very precise and clear. Information should include the syllabus, announcements, assignments, as well as interactively designed questions for the bulletin board. Supplementary materials such as a course manual and videotapes can also help understanding of a desired assignment outcome. Students appreciated the clarity of instructions and deadlines expressed at the onset and during the course. Students' questions and comments about assignments and instructions shed a great deal of light on how well you have expressed the course content and what corrections are necessary in the future.

Communication between teacher and student is extremely important. The process of technology implies we are available anytime and anywhere. Many students come to expect faculty to immediately respond to their e-mails. Our bodies and minds move slower than the technology available. A reasonable response time may be 24 hours. However, there are certain times when the 24 hour response time may be suspended because of weekends, vacations, and conference excursions. Announcements of these times are a simple matter of courtesy; and relieve much negativity and stress which could happen if not known by the student. Students appreciated being informed of equipment failures on the course site system. This notification eased their anxieties concerning the possible failure of their own computer equipment.

Professional Networks

Developing and maintaining a professional technology network can be a very enlightening and enriching experience for its membership and the clientele it serves. Several years ago, we established an annual "Sharing Day" workshop for our state professionals. Its idea was to invite professionals to a site for a Saturday to share their best teaching activities, ideas for classroom management, and their common interest in becoming better teachers in their profession. Also, it was to be opportunity to become acquainted with other professionals around the state in their discipline. It was hoped that through this meeting, the professionals would discover each other's talents and create a network of individuals which could be contacted when specific needs or questions came up regarding professional issues. These "Sharing Days" were a rousing success for several years. As professional and family responsibilities became more evident, attendance at these sessions began to drop. In the meantime, technology became more and more commonplace in our schools. With the development of distance learning courses, an electronic masters, and summer intensive workshops in technology, we decided with encouragement from our distance learning students to use technology in re-establishing our professional contacts in the state? Thus, the Kansas Health and Physical Education Network was born.

Ground work for a network. A network needs boundaries to start from to assure its success. Geographically, the state of Kansas was a starting point because our familiarity with the schools, their technology systems, and their teachers. Professionally, common interests must exist. Personal contacts were made with various health and physical education teachers geographically dispersed across the state to determine those individuals with an interest in a technology network and who had the available technology to participate equally with others in our initial undertakings.

The beginnings of a network. A small, manageable number of 20 professionals were identified to pilot this network with the idea of adding and encouraging others to join as the network progressed. E-mail communications with these individuals were established and a website was linked from our state professional organization's home page so not only the network group but guests as well could access it. Our professional organization, the Kansas Association of Health, Physical Education, Recreation and Dance (KAHPERD), gave us a grant to travel to four schools sites, one in each professional district of the state, to visit teachers and survey their technological capabilities. This gave us an opportunity to become familiar with the technology in our state schools. Teachers from neighboring schools were invited to attend these meetings for information on the network and the use of technology in our profession.

The network's future. With the network now in place, brainstorming was initiated through our website forum to determine and prioritize possible functions of the network. Clearly our first functions were to develop information sources on our network website to alert professionals to legislation affecting our programs and the sharing of lesson

activities for various grade levels. Also, the forum discussion initially pursued technical ideas on producing web pages for the school programs of network teachers. On the horizon, it is planned to have spreadsheet applications and other software orientations relevant to the teachers' needs in their programs. Also, integration with other disciplines/ teachers will be discussed. The recruitment of other teachers to network is an on-going process. Collaborative presentations for our next state KAHPERD conference to help other professionals with the advent of technology in their schools are being planned.

Visions For the Future

University teacher education programs must realize that technology-based education is here and is rapidly changing each day. Our intent was to relate how we have met the challenges of recent trends in education which suggest that the demand for information technology-based teaching will grow in the next decade and this technology will change teaching and learning profoundly. Our paper has discussed how we are utilizing educational technologies in innovative ways for teacher excellence, and improving the delivery of our teacher education system to a wider professional audience.

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Approaching Internet Course Delivery: A Developmental Structure for College Classes

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All courses undergo regular examinations to insure that they are current, theoretically supported, and consistent with the rest of the curriculum. In addition, many faculty members discover the necessity of examining their offerings for technological currency. The pressure to offer courses through distance media and with a variety of optional technologies makes it difficult to limit revision to simply updating bibliography. Such curriculum development has proven to be as troublesome as it has been necessitated by innovative departmental administration or clamoring students.

This investigation is predicated on the assumption that the instructor's task is not to invent an Internet course, nor to make a single adaptation of an extant course that will make it, once and for all, instruction on the cutting edge. College instructors develop their courses gradually, over three or four iterations, in a way that allows continuous effort to produce an evolving product. Consideration for the abilities of incoming students and the technical infrastructure (that of the institution and of the participant students, as well) will guide the rate of development. Instructors' general level of exhaustion will have a role, also.

The stages of Internet course development for teacher and student follow a life cycle that describes and may predict a pattern of instructional development that moves the course from a traditional classroom to a completely Web based asynchronous offering. In each instance, the instructor makes three kinds of choices: instructional design (goal sequencing, lecture strategy, for example), student expectation (read text, go to library), and instructional material (text, article, chalkboard). In the process of developing a previously taught course for the Internet, the instructor makes a series of decisions concerning the instructional value, the academic integrity, and the institutional efficiency of the methodology used.

In the relationship of the individual instructor to the subject matter of a course and to the individual students in a class, the research is not extensive. The individual choices of how to teach, how to evaluate, and how to be fair to each student remain unreported, perhaps because these matters have always are dealt with by instructors individually. They are decided as a result of institutional policy, but not interactively with it.

Designing and delivering instruction consists in choices: selections every teacher makes that begin with deciding whether to engage in detail or in span of subject matter and end with wondering whether individual progress or achieving an absolute benchmark of information is the proper criterion for grading.

Student activities mirror instructor choices. The three student categories are attention to class (listen, memorize lecture), analytical skills (read critically, write brief essays), and response (take tests, write book reports).

Classes that move gradually to the Internet can follow a progression that involves both teacher and student in changing skills. Here is an outline of the way the instructor can lead both one self and one's students along that progression. Earlier stages of this development should be familiar to everyone. Later stages are richly displayed at Internet instruction collections like The World Lecture Hall http://www.utexas.edu/world.lecture/edu/

Classroom instruction is the starting point: the traditional model. It employs lectures, handouts, and visual presentations on the board, with assignments of critical reading from text, library, and journal sources. Supplemental presentations are made, in class, with chalkboard or transparencies.

In some ways, this is the most flexible system of instruction. With the door closed, no one but instructor and students knows what occurs in class. An outline or a graph written on the blackboard can be changed to need the apparent needs of the class at the moment it is being drawn. Class discussion changes from section to section, but lectures or examples may change as quickly. Certainly, large classes or an instructor's dependence on notes will diminish the interactivity of a class. Nevertheless, the traditional classroom always involves a lecturer looking at students, and students expressing their degree of attention by expression, body language, question, or comment.

Lectures and demonstration are truly evanescent, and (barring a tape recording) the interaction cannot be recaptured or duplicated in future.

Media-conscious classes tend to supplant lectures with projects. Instructor handouts begin to be supplemented by URLs and information available on-line.

Chalkboards become supplanted by sets of prepared transparencies. And those transparencies are replaced by PowerPoint presentations. Indeed, the transition from writing on a chalkboard to designing a presentation often has designed transparencies as an intermediate step, lasting several semesters. Seasoned instructors, distrustful of projectors' reliability, routinely include static transparencies as part of their preparation, even when they desire to use only a projected presentation in class. Examples and assistance are available at The Campus Café http://www.presenteruniversity.com

Slideshow software does not lend itself to correction during a presentation, of course. Hoping to maintain a degree of student self-direction, instructors tend to use the presentation to set up situations, establish rules, or introduce broad outlines. Students find themselves encouraged to elaborate on the outline, rather than attending to didactic detail in a lecture. Thus does the technology begin to change the role of students within the classroom.

The existence of presentation equipment in a classroom suggests access to computing resources of other sorts. Instructors with PowerPoint have, by the nature of their exploration, gained access to other electronic instructional tools. As Compel can replace a chalkboard, databases replace indexes, URLs supplement tomes, and tutorial programs become part of re-teaching strategies.

Text-intensive Internet courses begin as a migration of the lecture and student discussion to a distance education medium (Moore & Kearsley 1996). This is the first realization of a class that can actually be exported to students at a distance who attend class electronically. In some ways, the text-intensive Internet course represents a retrograde step in instructional delivery. E-mail, newsgroups, MOO and MUD environments all lend themselves to instruction. However, they do not accommodate graphics or the (presumably) visually appealing presentations available with a projecting computer or a well-designed transparency.

They do provide a realization that any interaction among students must be accommodated — encouraged — by the instructor through the media that propel the class. The first Internet class is often the first collaborative class, as well (*Bernt & Bugbee, 1993)*The University of California Extension demonstrates a wide variety of media at http://www-cmil.unex.berkeley.edu/

Internet classes share with other distance education programs an unpredictability of uniform resources outside class material. A true distance offering can make no assumptions about library, laboratory, or archival resources, except those available through the Internet itself. Therefore, the technology forms a change in instructor expectation and student behavior as Internet resources become the core of student investigation.

The Web Course replaces the Internet course when visual tools and instructor skills outstrip text's limitation. Lectures (texts), presentations (graphics), and resources (links) become integrated. Please note several examples posted at http://www.tec.nsula.edu

Student activities become differently arranged, as well. Traditionally, a student is asked to prepare before a class, engage in class activities in the same order as other students do, and assimilate or apply the class activity in assignments or research. In the Web class, students are in control of their counterpart to "class time." Instructional material may be consumed at a rate suitable to the student's learning style and schedule. More important, preparation, instruction, and response cease to be discreet activities. A student can receive a lesson, read the assignment in the light of the level of understanding the lesson requires, and construct an assignment or pursue research at the same time the parts of the lesson are being received. Time management and study habits lose the structure required by the preparation/attention/response sequence of scheduled classes.

The result of this progression can be seen, not only in technological sophistication, but also in the learning and instructional activities of the participants: instructor and learner alike (Roberts & Keough 1995).

Every technological choice affects the learners in different ways, and is intrinsic to the subject matter of the class and the expectations of the instructor. Teaching people at great remove from campus, and expecting them to interact with each other and with the intellectual substance of the class without seeing one's self or each other, requires a reexamination of dozens of instructional decisions that were made for the classroom. Continuous revision of instructional strategies requires a parallel revision of the assumptions about the way students receive, respond to, and retain the material of every class. Revision also requires evaluating feedback carefully. Changing so much in teaching methodology is a little frightening. Changing it without being able to see or hear students' reactions to the changes can, and probably should, terrify any instructor.

Detailing the choices being made, and examining those choices in light of student feedback and other people's experience, seems the minimum price of this degree of innovation.

Internet-based communication has become a staple of academic communication: the whole system was invented to allow academics to work and talk at a distance. Not offering instruction in this medium deprives students of the opportunity to become comfortable in this central frame of discourse. And not allowing — requiring — this kind of access should be more disturbing than innovation at any level.

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Increasing Use of the World Wide Web in K-12 Classrooms: An Implementation Project

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The Department of Education and Human Development of the State University of New York at Brockport is in its third year of a Goals2000 funded project to increase teacher knowledge and use of technology in K-12 schools. The project has involved placing hardware in individual schools, training teachers to use the hardware, networking the schools, setting up a listserv, and having periodic meetings and mini-conferences. SUNY Brockport has been involved in both the in-service teacher training and primarily in the pre-service training of future teachers.

Each year the number of schools involved has increased. The first year, 1995 – 1996 involved the placement of hardware and training of a core of teachers in four schools on the use of the hardware, e-mail, and list-servers. The focus during the first year was for each school to develop an operational definition of professional practice school as it would be implemented at their site. The technology was used as a support to communication among schools and SUNY Brockport.

The second year of the project, 1996 – 1997, involved the addition of four more schools and a focus on multimedia applications in the classroom. Teachers in participating schools were trained in the use of HyperStudio and encouraged to use it in their classrooms and with their students. Each of the participating schools continued to use the provided technology both for communication with other members of the project as well as for the development of multimedia presentations. During this second year a core of teachers at participating schools were also introduced to the Internet, the World Wide Web, and Netscape as resources for their teaching.

In an attempt to encourage more use of Internet resources in the K-12 classrooms, the third year of the project, 1997 – 1998, added 1 more school bringing the total to nine, and focused on introducing teachers to a World Wide Web subscription service developed by American Cybercasting, called *Educational Structures*. Teachers at each of the nine participating schools were trained on the use of this new tool and encouraged to use it in their classrooms. Pre-service teachers at SUNY Brockport were also trained on the use of *Educational Structures* in their classes at the college so that they could serve as resources to teachers and students in the schools in which they were participating. The third year of this College — District Learning Community project serves a total of 180 pre-service teachers, in-service teachers, and college faculty from SUNY Brockport and Monroe Community College

Educational Structures

Educational Structures is essentially a subscription service which uses the World Wide Web as its resource as well as its delivery system. *Educational Structures* is designed for use by both K-12 students and teachers stated to be "a K-12 Internet-delivered curriculum service for both educators and students." It is organized into the subject areas of Social Studies, Science, Math, Language Arts, and Health. These subject matter subdivisions are called "wings," using the metaphor of a large library. In addition to wings devoted to specific subject matter areas, both students and teachers can access the Media Center wing for additional resources. Teachers have tools available only to them through the Main Office part of Educational Structures which requires a user name and password for access. In the Main Office teachers can find lesson plans, assessment ideas, and a roster of other teachers who are using *Educational Structures*.

Student use of the *Educational Structures* system allows for subject exploration and tutorial type lessons, self assessments, and collaborative projects with students from other schools, districts, and states. Students can access dozens of publications including newspapers, magazines, and journals all of which allow free copying and distribution of articles through prior copyright agreement with *Educational Structures*.

Each wing of the *Educational Structures* organization has the same appearance to users to facilitate ease of use. Each wing provides four to six different specific subdivisions of the wing, appropriate to the subject matter repre-

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sented. For example, the Language Arts wing provides the subdivision areas of Reading, Writing, Speaking, and English Language; each with its own "Information Stations." These "Information Stations" guide and facilitate student or teacher exploration of the specific area of the chosen wing. In addition, each wing as well as each area subdivision of each wing contains specific tools for users. These tools are: Search, Activities, Publications, and Joint Ventures.

The Search Tool allows the user to search Information Stations, Newspapers and Periodicals, or Webster's New World Dictionary. This tool is a highly specific search engine for easy use within the *Educational Structures* environment. Searches are further facilitated by the user typing in specific terms or phrases and/or specifying time periods for the search.

The Activities Tool is subdivided into the same areas as the wing and provides the user with learning activities which are color-coded to indicate the appropriate grade level. Teachers can use these as activities for the entire classroom and project information onto a screen or students can use them individually. The learning activities are much like lesson plans in that they contain objectives, materials needed, and instructions. The activities differ from lesson plans in that a student or group of students can do them without the intervention of a teacher.

The Publications Tool provides the user with a list of periodicals. The user can access the entire list or can look for periodicals collected by month. Once the user chooses a periodical and selects it, a full listing of articles is displayed. Choosing one of the articles displayed provides the full test of that article.

The Joint Ventures Tool is a unique one in that it taps the full capabilities of the Internet. Joint Ventures are initiated by teachers or students through a teacher. *Educational Structures* provides assistance to the teacher in posting the joint venture in an appropriate format. These joint ventures vary from collection of temperatures around the country to writing poetry about your particular location. In short, the Joint Venture Tool provides students with electronic pen pals with a purpose and structure.

The Main Office Wing, open only to teachers provides tools which allow teachers the ability to incorporate *Educational Structures*' wealth of information and activities into the classroom. Available are: lesson plans and interdisciplinary units written in a common and standard format, interdisciplinary thematic activities and enrichment opportunities, custom lesson plan support, related Internet sites, a counselor's corner for information related to teen problems, and a user's roster to provide a list of other users of *Educational Structures* so that teachers can share ideas and ask questions.

Educational Structures provides both students and teachers with an organized window on the Internet. In addition to a safe and organized interface, users are supplied with lessons, activities, units, related sites, and other related resources. The key is related, so that the teacher or student does not spend endless hours searching the Internet with no concrete results.

Implementation

To encourage and enable teachers to use the Internet and the World Wide Web in their K-12 classrooms, each of the nine schools involved in the Goals 2000 project were provided with 20 licenses for access to *Educational Structures*. Internet access and hardware were provided where schools did not yet have access.

An informational meeting and kick-off session was held in May of 1997 to introduce teachers, administrators, and college faculty to the *Educational Structures* and the objectives of the third year of the Goals 2000 project. Beginning in the summer of 1997 and continuing into the fall, half-day training sessions were held for teachers in the nine participating schools. Follow up training sessions were held individually in each of the participating schools. These training sessions were led by the school district technology implementation teachers.

In August of 1997, just prior to the beginning of the fall semester for SUNY Brockport, a half-day training session was held for the faculty in the Department of Education and Human Development. Because of the excitement generated by *Educational Structures* 10 additional licenses were purchased so that faculty could have access in their own offices and not only in the Educational Computing Lab, which has 20 licenses. Faculty were encouraged to incorporate *Educational Structures* into their existing methods courses during the fall and spring semesters. The goal was to supplement material already taught in those courses, not create a separate mini-course on *Educational Structures*.

The use of *Educational Structures* was implemented in two different elementary methods courses, the secondary English methods course, the secondary Mathematics methods course during the fall semester of 1997. During the spring semester it will be incorporated into the remaining two elementary methods courses, and the two remaining secondary methods courses.

Students from the methods courses using *Educational Structures* are involved in school participation while in those courses. Many of those participants, mostly in the elementary methods courses, are able to use their learning of *Educational Structures* in the schools in which they participate. The numbers of the students doing so will increase in the spring semester.

Evaluation

In order to evaluate the effectiveness of training in-service and pre-service teachers in the use of *Educational Structures*, the authors are developing a series of questionnaires, interview protocols, and indicators of World Wide

Web use by K-12 teachers and students in target schools and at SUNY Brockport. The evaluation process will involve students as well as teachers in K-12 schools and at the college.

Survey questionnaires will focus on knowledge of *Educational Structures* and the World Wide Web in general. One survey will focus on student use and will be in three different versions, one for elementary school students, one for secondary students, and one for teacher preparation students. Another survey will focus on instructor use and will also be created in three versions, one for elementary teachers, one for secondary teachers, and one for college faculty.

In addition to surveys, random individual interviews will be conducted with a sample of students and instructors from each level.

Data will also be collected on number of times and length of connect time for each station connected to *Educational Structures*. Since *Educational Structures* is provided by IP address, collecting data regarding usage can be traced to individual classrooms or offices.

Preliminary Observations

Even as the surveys are being developed, feedback on *Educational Structures* is very positive. Teacher preparation students at SUNY Brockport as well as faculty find the service extremely easy to use. The college faculty was particularly impressed by the ease of use and many who had been very reluctant to use the World Wide Web have now begun to do so on a regular basis because of the introduction through *Educational Structures*.

Students in the Dimensions of Teaching course, the first level elementary methods course, were required to use *Educational Structures* to find and print out three lesson plans; one in science, one in mathematics, and one in either social studies or language arts. One of the professors team teaching this course then based a lesson on critiquing and improving lesson plans on these plans. The step is a big one since last year students were asked to write their own lesson plans.

The general feeling among students and faculty alike is that *Educational Structures* is a good tool in the teacher training program at SUNY Brockport, and one that is likely to remain available.

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INTRANETS: SAFER, MORE EFFECTIVE INTERNET USE IN K-12 EDUCATION

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The primary goal of this project is to find a way to make more effective use of the computers and Internet access available in our K-12 schools. With the cooperation of the administration, faculty, and students at the Anthony T. Lane Elementary School in Fairfax County, Virginia, we have begun building an Intranet (internal Internet) to catalog school resources, student projects, and Internet sites that are useful in the daily learning and teaching process. The system is called the Internet Research Center (IRC).

To begin building the IRC, we organized a group of 14 fifth and sixth grade students that meet once a week after school. With guidance from the faculty, these students select topic areas, research the available resources within the school and on the Internet, and then develop HTML pages that catalog what they have found. The HTML pages are categorized into a hierarchy of *People*, *Places*, and *Things*. Many students were interested in taking on this extra research, because they were able to learn more about the Internet and present their work in the interactive multimedia format supported by HTML.

Although the students are learning more about computers, HTML, image scanners, and the networks, the emphasis is on education supported by the technology, not education about the technology. For the IRC to be successful, however, students and faculty members have to be able to easily add and update information in the system. To facilitate these updates, a set of HTML templates have been built. These templates are generic HTML pages that a student can select and then populate with their text and images. The templates reduced, and often eliminated, the need for students to format their work with complex HTML tags. The templates also give a more uniform look to the many diverse topics included in the IRC.

Lane "Internet Research Center" Project

The IRC system's interface was designed to be simple enough for students in second and third grade to use, while offering the breadth and depth of information needed by students in fifth and sixth grade. The interface encourages exploration through reference materials and entices the student to take the initiative and explore related materials. The top level of the IRC has all topics categorized as People, Places, or Things. Figure 1 shows the top level People page. From here students can link to comparable pages for Places or Things, or drill down to see pages on specific people, like to one shown in Figure 3 on the Egyptian pharaoh Sneferu.

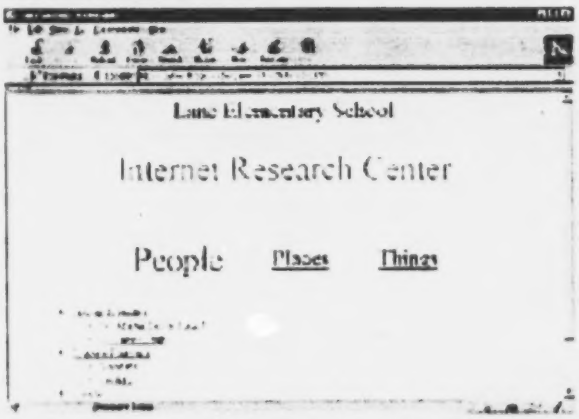

Figure 1. Top level page for People

The hierarchy of topics is fairly shallow (only a few links deep) over most of the materials. A student can link directly to a specific page from the top level in many cases. Other topics, like Our Solar System (shown in Figure 2) can be linked to from the Places page, but they contain too much material for a single page. In cases like this, another level is added to the hierarchy.

The IRC uses the flexibility of HTML to form links among pages with related materials. For example, the page on Sneferu, shown in Figure 3, can also be linked to a page on his son Cheops and a general page on pyramids. The Sneferu page is also an example of a template that is used widely for biographies in the People section. This template includes the person's name in bold in the top left corner. The dates they lived between under the name and a picture embedded in the free text on the right side. Most templates have areas for Internet references and internal school

BEST COPY AVAILABLE

resources (such as videotapes and library books) at the bottom.

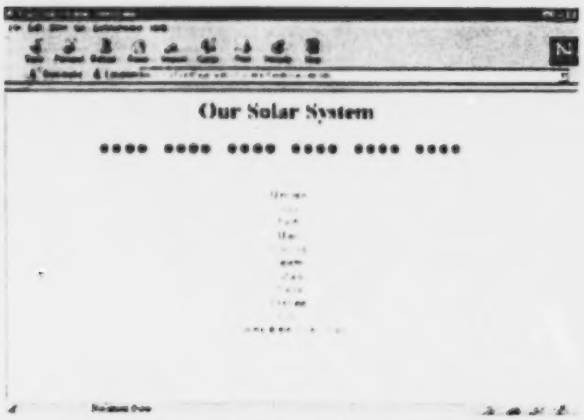

Figure 2. Table of Contents for Solar System Pages

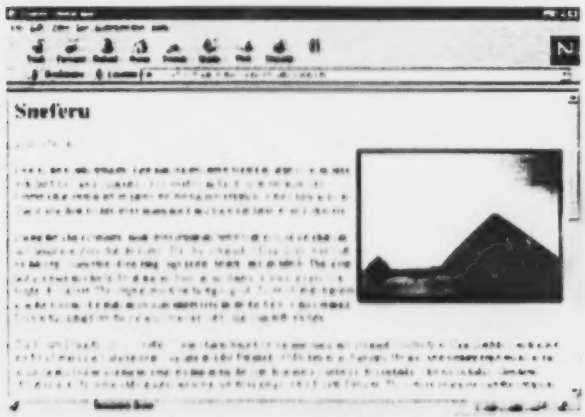

Figure 3. IRC page on the Egyptian Pharaoh Sneferu

Challenges

The four main challenges facing the development of a system like the IRC are:

1) getting the basic tools in place, including the computers, software tools, and network facilities;
2) overcoming the cultural hurdle of introducing something new and turning it into something necessary;
3) finding and tracking useful resources on the Internet; and
4) maintaining the system as it grows.

With the first challenge, we were fortunate that Fairfax County had already provided the computers and network to the school. In addition, the school had also been furnished with a flatbed image scanner and two digital cameras for digitizing images that could be quickly incorporated into IRC Web pages. The one software tool we were missing was a WYSIWYG HTML editor. The HTML templates we developed greatly relieved the need for an HTML editor, because the students could edit the HTML templates in a simple text editor. We, however, need to identify an HTML editor soon so that the system is more accessible to everyone.

Overcoming cultural hurdles takes time. The overhead of using computers in schools is formidable and can not be overlooked. Teachers and administration are already under time pressure with their traditional duties. Adding computers to the classroom, lab, and library that require maintenance, software installations, and reconfiguration, without new staff to perform these tasks, simply overburdens the existing people. Even though the IRC is seen as a useful tool, the time required to maintain it can not fall solely to the teachers. For this reason, we worked hard on student and parent involvement in the development. Teacher involvement was, however, still critical. The IRC must support the program of study to be useful in the classroom and the teachers were instrumental in keeping this on track.

Finding and tracking Internet resources can be a time consuming task. Sometimes the best Internet resources are the hardest to find. Some sites are well indexed and leap out of search tools, while other sites are like buried like fossils (invaluable, but requiring great effort and some luck to find them). The Internet is also a dynamic resource. Web pages can change addresses or disappear without notice. Many sites are abandoned and out of date. As the IRC grows, it needs to take advantage of some of the new Web page maintenance systems that help track links that no longer work. This is, however, only part of the problem. Teachers and parents need to monitor the links included in the IRC to make sure that they are relevant and current.

As any experienced software developer can tell you, building a new system is the easy part. Maintaining it over long-term use is the most significant effort. One way to reduce the cost of this long-term maintenance is to use standards whenever possible. Standards reduce the cost of upgrades because there are competitive solutions to choose from and standards are more likely to maintain backward compatibility. Because we were building Web pages that would be seen on both Macintosh and Windows computers, we built all of the pages using standard HTML. We avoided extensions that were not supported by all browsers. Even as the Web migrates from HTML to the more powerful XML standard over the next few years, HTML will still be supported by browsers and will still be used by many Web developers.

Conclusions

We hope that as a result of the IRC, teachers will encourage students to browse the school's internal resources, knowing that relevant materials are readily available. Teachers know where the materials are so that the

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time spent using the Internet is more productive and predictable. Although students still have access to the "Wild West" of the Internet, teachers are more confident that they can supervise this access, because most of the student's time is spent on internal Web pages and pre-approved external sites.

The interface has been designed to encourage short web pages that are linked to related topics. Not just reading on a computer screen, the IRC is an on-line, organized reference to previous projects, reports, and resources for further research. Students seem to be less inhibited to explore and review one-on-one with a computer than in a classroom setting.

The long-term success of the IRC depends on getting everyone involved. Teachers need to use it as a teaching device and as a resource for their own lecture materials. Exemplary student projects can be archived in the IRC and used to teach others and serve as an example to others. As a Knowledge Management System, the IRC can only succeed if the teachers and students feel a compelling need to use the system and have a sense of ownership and control over it.

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TELECOMMUNICATIONS: PRESERVICE APPLICATIONS

Section Editor:
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Technology, computers, the Internet, distance education - all are words heard with increasing frequency, and ones that are influencing our personal and professional lives, as well as the very fabric of our society. In education (as well as in the business world), there are many examples of how time and location are no longer barriers to collaborative endeavors, as the new technologies enable us to work together in environments without either time- or distance- limitations. At the other end of the spectrum is the growth in classes and workshops designed to provide people with opportunities to learn to use computers (and other technologies) at all levels, from beginning to advanced. Not to be forgotten are those people who have no knowledge of or skills with computers, some of whom because of a conscious decision they have made, but others because of lack of access to the technology.

What does this mean for teacher education programs? We are already seeing some of the effects of the increased numbers of computers in K-12 schools, as many students enter higher education with computer skills that surpass that of their instructors. With Internet access at home and/or at school, many of today's students are also experienced in the area of on-line communications. Does this mean that teacher education programs can jump right in and join the movement to on-line activities?

The papers in this section provide some insight and guidance in a variety of areas related to telecommunications in teacher education programs. These include some actual distance activities (via video teleconferencing or the Internet), as well as suggestions for training and support activities that will promote effective use of the Internet. The technologies this year include video conferencing, web conferencing, along with web training and use, with themes of telementoring, collaboration, information seeking and retrieval, and others. These may be included in combinations within various papers - a recognition that technology is just a tool, and that the various technologies can be combined as appropriate to provide the most effective teaching/learning environment for our teacher education students and faculty. Many of the following report data from formative and/or summative evaluation of the various projects, providing the rest of us with some suggestions and guidelines that we may use when designing our own telecommunications activities.

Joyce Lynn Garrett and Kurt Dudt describe a high-tech way to minimize the cost of supervising student teachers while adding diversity to pre-service teachers' classroom experiences. Their program uses video conferencing to supervise student teachers who are at distant sites. Video equipment in the classrooms allows the university supervisors to observe, and then to meet with the individual student teachers and their cooperation teachers. Despite some technical problems, the response has been positive, and the program will be expanding.

A different type of video conferencing experience is reported by Carole S. Rhodes, who describes the use of distance education in a pre-service graduate teacher education program. Originally designed in a traditional one-site format, the course was changed to a video distance education format when six students from another campus wished to enroll. Rhodes reports the reactions of students at both ends (sending and receiving), and suggests some key themes and issues that must be addressed when using this method of instructional interaction. An interactive-web site and an emphasis on the importance of reflection, were also course essentials.

Reflection and the web both are included in the project reported by Charoula Angeli, Lauren Supplee, Curtis Jay Bonk, and Steve Malikowski. In this study of preservice teachers' use of an asynchronous web-based conferencing program during their early field experiences, research questions included the areas of dialogue (topics), help (requests and given), indicators of effective mentoring on the web, student attitudes, and the relationship between conferencing tools and new expectations related to teaching and learning. Quantitative and qualitative findings are discussed, and the authors mention a follow-up study that will be forthcoming.

Jean Casey's paper also addresses the issues of the web and student teacher reflection. She describes the current

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status of TeacherNet, a project that involves student teachers in telecommunications. Student teachers, having Internet skills before they go into the classroom, are important resources, as they "lead the way by working side by side with other teachers and helping them acquire the necessary skills for information evaluation and retrieval to use in their classrooms and to model for their students." E-mail facilitated communication among student teachers, university supervisors, and each other, developing some networking that continues as support even after graduation.

Barbara Brehm describes a study of another type of Internet activity for teacher education students. NetWorkPlace was developed to provide a visual component to support on-line communications. Pre-service and in-service teachers were involved in a mentoring relationship, with the mentors enrolled in a graduate Language Arts and Technology graduate class. Brehm addresses topics discussed on-line (classroom management was discussed most), perceptions of the experience, and suggestions for those planning future research on telementoring of preservice teachers.

A still different approach to using the web is described by James M. Laffey, Dale Musser, and Thomas Tupper. An interactive shared journal system was created to facilitate the reflective learning process from field experience. The authors describe and illustrate the system, discuss its use by faculty and students, and conclude that the program does promote reflection.

Robert Lucking and Marc Childress also describe a project using telecommunications to promote interaction between two distant groups of persons. Theirs is a tutoring/telementoring activity between prospective teachers and elementary school students, using an advanced distance learning system that included individual work stations with audio, video, and video board capabilities. Preliminary reactions are included, as is a list of questions for further consideration.

The next four papers look at various aspects of using the World Wide Web in instruction. Nancy A. Tate describes a hands-on web-learning experience for elementary teachers, "designed to familiarize then with the resources available on the World Wide Web so that they could use the Web as a tool to enhance their teaching." A key factor was the curriculum connection. Tate discusses the preparation, as well as specific activities for implementation, and some evaluative comments. Of special interest is the list of Critical Success Factors which might be consulted when planning other such activities.

The papers by Raymond S. Pastore and by Roy Tamashiro both examine the use of the web for research. In the first, Pastore addresses several questions related to resources given to students to conduct Internet research and describes a study of 250 elementary and secondary teacher education students and their required Internet research activities. In the second, Tamashiro provides specific guidelines for teaching secondary and university students to conduct web-based research. Suggestions relate to everything from infrastructure to selecting and focusing a topic, through searching, finding, compiling, and publishing. Ideas for minimizing plagiarism are also included. With the increasing use of the Internet for research, it is essential that pre-service teachers have, and are prepared to teach, the required skills.

Roberta K. Weber and Perry Schoon look at the web from a navigational viewpoint. They address several issues identified in two independent studies (at one university) when using the World Wide Web in instruction. The findings indicate that there are specific barriers that inhibit the students' efficiency when using the web for learning, and some of these are related to difficulty in navigating through the web while searching for information. Weber & Schoon suggest that, to minimize frustration of web users, there is a need for instructional design considerations (of web sites and pages) that support learning.

The next paper describes a program that provides students with a very concentrated "boot camp" approach to learning various technologies to use in support of education. Abbie Brown explains how this intense two-week session was preceded by three-weeks on-line, for students to get to know each other and to begin some of the organizational activities to prepare them to come to campus and to participate in the "boot camp" computer activities. This model of combining on-line course activity with an on-campus intensive-study component is one that might be considered as we search for new combinations of delivery methods, in an attempt to find the most effective and efficient way to provide educational experiences for our students.

We often hear that telecommunications and distance education are the way of the future. As with other educational practices, though, it is essential that if and when these are used to promote teaching and learning of students at any level we examine them carefully to make sure that they are the most appropriate, efficient, and effective means with which to accomplish our objectives. The authors of the papers in this section are doing just that. They are innovators, sharing their experiences and findings with us.

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Using Video Conferencing to Supervise Student Teachers

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The cost of supervising student teachers has become a concern for colleges and universities across the nation. The impending teacher shortage means that already large programs will grow even larger. Already overwhelmed local schools will feel the impact even more seriously. In addition, the demand for more diversity of experience means that most teacher education programs, especially those of universities located in rural areas, find it necessary to place student teacher farther and farther away from their main campuses. The idea of supervising clinical experiences of pre-service teachers using video conferencing grew out of a need to reduce costs associated with teacher education. It takes about $14000 a year to educate each teacher candidate at Indiana University of Pennsylvania (IUP). Costs will escalate as demands for less reliance on local schools and more diverse experiences continue to increase.

IUP places student teachers in 150+ school districts from Pittsburgh to Philadelphia and from Bedford to Erie, an area of more than 60,000 square miles. It has also developed partnerships with Indian reservations as far away as North Dakota and Arizona, and has partnership schools in Great Britain and Western Europe. Supervision in these distant sites is both costly and time intensive. In most cases, the faculty must be away from regular duties for two or three days; but in some cases, supervision requires them to be away for extended periods and they must arrange teaching and research activities accordingly.

Attempts to reduce financial burdens to the College of Education and ease faculty stress by using site-based supervisors from local colleges and universities have fallen short. In the best situations supervisors may not be fully familiar with the teacher education program at IUP so supervision does not meet desired standards; in the worst instances, contracted supervisors have failed to visit their student teachers even one time during the 14 week experience, which is unacceptable at a university noted for a quality teacher preparation program.

One solution that has shown promise is use of video conferencing to supervise student teachers in distant locations. The College of Education at IUP received a three-year grant from the United States Department of Education, Fund for the Improvement of Postsecondary Education (FIPSE), to conduct research and evaluate video conferencing as a tool for reducing costs of supervising clinical experiences in the teacher education program at IUP. The goal is to determine whether quality supervision can be achieved and high levels of student teacher achievement maintained.

Millcreek Township School District in Erie, Pennsylvania seemed an ideal place to launch this work. Millcreek is an Apple School of Tomorrow and a technology partner with IUP. The district was involved in many technology exchanges with IUP, from meetings to in-service education for teachers to "teach-ins" by secondary science students; but no student teachers had been placed there.

The District had the potential of providing an outstanding experience for student teachers from IUP, but the District's location, about two and one-half hours away from IUP, was a limiting factor. Placing student teachers in this highly desirable setting was especially difficult because traditional supervision was nearly impossible given winter weather conditions in northwestern Pennsylvania. Discussions of ways to resolve the problem gave way to planting the seeds for this project.

Equipment and Networking Needs

What does it take to make supervision by video conferencing work? It takes dedicated work of professionals and technical staff, plus equipment and a network. The facility includes three essential elements: a CODEC unit, a network, and a room (Brooksby, 1994).

One CODEC unit must be installed at each of the two or more sites in the video conferencing network. The CODEC digitizes and compresses video and audio signals for transmission (Brooksby, 1994). Working together, each CODEC sends and receives signals.

Compatibility between different manufacturer's CODEC units has been a problem. Users had to have the same manufacturer's CODEC unit at all sites to communicate. Recently, the industry has established standards of compatibility (H. 320) to permit communication world wide

between different manufacturer's CODEC units. Also, video conferencing equipment now combines key components into a single system. Cameras, microphones, monitors, speakers, and control panels are integrated into one easily moveable unit. When considering video conferencing CODEC units, make sure that it has the international video conferencing standards of ITU-T H.320.

Support equipment needed to obtain maximum usage from a system should include a document camera, wireless clip-on microphone for instructors (or student teachers), table or ceiling mounted microphones for participants (classroom students), an auxiliary camera (for more than one camera angle), and a VCR designed to tape or show videos. Additional monitors may be used also to facilitate the interactions of large groups

The network transmits information to and from CODEC units. A variety of formats can accomplish this task, including fiber optics, ISDN lines, and TI (T-one) lines

Fiber optics—A communication medium based on laser transmission. Glass or plastic fiber carries light to transmit video or audio data signals. Each fiber can carry 0 to 150 megabits of digital information per second or 1,000 voice channels. Transmission can be simplex (one-way) or duplex (two-way) voice data and video service (Portway, 1994).

ISDN lines—The Integrated Services Digital Network is a set of standards that transform an ordinary telephone line into a high speed data line capable of carrying information at 50 times the speed of conventional phone service. ISDN lines can carry extraordinary amounts of information (Hetrick, 1994).

TI Lines—These high-speed digital data carriers deliver very high quality visuals, but are more expensive to use than ISDN lines.

ISDN lines were chosen because of their availability in Western Pennsylvania. Three lines provide a transmission rate of 386 KBS, an acceptable speed for transmitting video signals. Lower compression levels have a lower price tag for each hour of video conferencing; but the cost is slower transmission time with poorer real time representation.

ISDN lines at low levels of compression, however, can produce satisfactory quality video, especially for visuals without significant amounts of motion. Motions appear jerky, with a "tail-like" appearance. Experience has shown, though, that slightly lower quality visuals do not negatively affect viewer's participation for educational purposes.

ISDN lines are also fairly inexpensive to operate. They are roughly equivalent in price to two times the cost of a long distance phone call to the same site (each ISDN line has two channels).

The most significant way to reduce the cost of operation is to do careful planning. Events should be preplanned, carefully timed, and based on clear objectives. Using these tips will mean moving smoothly from point to point in video conferencing activities ranging from group discussions to the supervision of student teachers.

Research and Evaluation

This project is designed to occur in three phases. The first was a pilot study to provide feedback for modifying and expanding the second and third phases. During phase one, three student teachers, three cooperating teachers, and two university supervisors volunteered to participate. Phase two, currently underway, involves 14 student teachers and their respective university supervisors and site based cooperating teachers. In phase three the number of "wired" sites will increase to three and the number of participating student teachers will increase to at least twenty-four. In each instance, a control group of carefully matched cohorts, who are participating in traditional site-based supervision, are providing data also.

Data were collected from participants in each of the three categories: student teachers, cooperating teachers, and university supervisors. A control group matched on all salient characteristics provided comparison data for the study. Pre- and post-experience data were collected about participants' attitude toward, use of, and satisfaction with technology-based supervision of student teaching. Although a cost analysis was also conducted, the analysis of those data is not complete.

These data were useful in guiding the planning process for Phase II of the project. Project staff have elected to report them, because they could be helpful, as well, to others considering the use of video conferencing to accomplish activities not normally associated with the technology.

Analysis of Attitude, Use, and Satisfaction Data

University Supervisors

Data for follow up evaluation were collected from two university supervisors, three cooperating teachers, and three student teachers. Each was asked to complete 14 questions on a written questionnaire. The outside evaluator for the project reviewed the questionnaires for completeness, clearness, and comprehensiveness. Questions were designed as closed-ended, open-ended, and Likert-type. All participants responded to all questions, making all data usable for the purpose of analysis. The small N for Phase I limits reliability of the conclusions and generalizability of results, however.

Two university supervisors, with 12 and 9 years of experience respectively, reported supervising between 25 and 30 student teachers to date. Both reported this experience as their first using video conferencing to supervise student teachers. Each reported using it to supervise her student teacher over five times during the semester. Observations lasted between 30 and 40 minutes.

Video conferencing was also used to conduct planning conferences, pre-conferences, and post-conferences. The 2 to 5 planning conferences for each supervisor and student each lasted about 10 minutes. Pre-observation conferences also numbered between 2 and 5 and lasted between 10 and 15 minutes. Between 2 and 5 post-observation conferences were held and lasted between 10 and 20 minutes on average.

One supervisor held both midterm and final evaluations using video conferencing. the other only the final one—she felt compelled to make her midterm in person due to perceived problems with the use of video conferencing in a special education classroom setting

Both report many positive aspects of using video: (1) it saved time; (2) they liked being part of an innovative project; (3) they developed skill in using video conferencing for future activities; and, (4) they like the collaborative nature of the IUP/Millcreek partnership. One also identified these: an otherwise unavailable site was made available, a definite schedule of observation was established, comfort and confidence levels increased with use of technology, and information from the experience was incorporated into a methods of teaching class.

Some less positive aspects of using video conferencing to supervise student teachers were also noted. Both suggested the audio quality was not adequate, a finding consistent with those from evaluation of the pre-student teaching experiences reported in an earlier annual report. At least one reported that technical difficulty with the ISDN lines and the ability of the local telephone company to deliver service affected her satisfaction rating.

Both university supervisors reported high levels of overall satisfaction with the system to supervise their student teacher. On a scale of 1-5, (5 was high), respondents were rated: overall effectiveness, quality of feedback they were able to provide students, and overall satisfaction with video conferencing.

One rated the overall effectiveness as 4 and the other rated it as 5. One rated the quality of feedback given using video conferencing as average (3), while the second rated it excellent (5). Both rated overall satisfaction with the use of video conferencing as high, One as 4 and the other as 5) and said they would use it again and would recommend it to others for student teaching related activities.

Finally, both made open-ended comments to explain their ratings:

US1: "I will be using video conferencing again this fall. I was very pleased with the experience."

US2: "Conferencing is sometime(s) awkward with video conferencing, especially when I haven't met the cooperating teacher in person. The conversation is sometimes stilted and seems a little artificial. I think that's probably unavoidable because this first semester held the awe of new technology for the student teacher, the cooperating teachers, and me."

Cooperating Teachers:

Three cooperating teachers responded to the same questionnaire. All are experienced female teachers; one with 18 years teaching experience and two with nineteen. Their involvement with the student teaching program is 1 year, 4 years, and 10 years respectively, with between 1 and 6 student teachers among them. This is the first time any of them have had an IUP student teacher.

Like their university supervisor colleagues, this was the first time they had used video conferencing as part of the student teacher supervisory process. When queried about their use of video conferencing during the semester, one said she used video conferencing one time for about 45 minutes. One stated she used video conferencing between two and five times during the semester for an average of 30 minutes; and, one reported using it over five times for an average of 45 minutes each time.

Cooperating teachers also used video conferencing for planning conferences, pre-observation conferences, and post-conference activities. One reported she did not use video conferencing for planning purposes; one reported using it for planning one time for 15 minutes; and, one used it for two to five times for an average of 45 minutes. Uses of video conferencing for pre-conferencing were also varied. Two reported never using video conferencing for this purpose. One used it two to five times for 45 minutes. One cooperating teacher used video conferencing during post-observation conferences two to five times for an average of 45 minute; two reported never using video conferencing for this type activity. Two cooperating teachers reported not being involved in the midterm or final evaluations; one reports she was involved in both for about 45 minutes each time.

Data reported by one cooperating teacher regarding her use of video conferencing for the purposes of planning and pre- and post-conferencing were inconsistent with data reported by university supervisors and student teachers. There is no explanation at this time for these inconsistencies. The questionnaire has been revised, however, in hopes this will address the problem.

Positive aspects in the student teacher supervision process were also reported by cooperating teachers. Three cooperating teachers reported as positive the fact that:(1) an otherwise unavailable site was made available; (2) they got to be part of an innovative project; (3) the university supervisor was made more available; (4) they became more comfortable and confident in the use of video conferencing as the project progress; and, (5) they developed skill to use video conferencing for future activities. All three also noted the collaborative nature of the IUP/Millcreek partnership as a positive aspect of their participation in the project.

Two of the three cooperating teachers reported time saving and knowing the schedule of observations in advance as positive. One supported the positive of advanced scheduling by reporting that establishing a definite schedule of observations was a positive aspect of using video conferencing.

Open-ended remarks by cooperating teachers suggest making video conferencing available for other activities. Another commented about the positive relationship between IUP and Millcreek and suggested that the system might be used as a way for Millcreek students to observe university classes in session (to help alleviate their anxiety about attending college—important for first generation college students).

Finally, two cooperating teachers stated they would use video conferencing again. The third one reported she might use it again, but did not list the conditions that would sway her one way or the other.

Areas which cooperating teachers thought could be improved were: scheduling of observations and meetings (2), video quality (2), audio quality (2), increasing the number of observations (1), more preplanning of the entire video conferencing experience (1), more mobile equipment (1), and making the equipment more available. One cooperating teacher expanded the close-ended questions by stating:

> **CT2:** "The microphone situation is clumsy. Stationary mikes [microphones] and one clip on [microphone for]...[make it difficult] to hear pupil answers and [student] teacher needs to repeat responses for the [university supervisor]."

Overall, cooperating teachers report video conferencing effective for the supervising student teachers. One rates it 3, another 4, and another 5 on a scale of 1-5 (5 is high). They rate the quality of feedback they were able to give or receive via video conferencing high. Two rated it 4 and one rated it 5.

Cooperating teachers' overall satisfaction with using video conferencing in the supervisory process was also high. One rated it 4 and two rated it 5.

Additional open-ended comments to support these ratings were provided by several respondents. Below is a typical quote:

> **CT1:** "This proved to be an exceptional experience for all student teachers. Our child development/ distance learning project received press from local news that created public awareness. Parents were impressed and proud that their high school students were offered [the opportunity] to participate."

Student Teachers

Three student teachers participated in the pilot project begun in the Spring Semester 1996-97. Two were students in the Family and Consumer Services Education Program (Home Economics) and one was a student in the Department of Special Education.

One student reported between 2 and 5 observations by the university supervisor using video conferencing equipment; one reported over 5 observations. Observations averaged about 40 minutes each. Planning conferences were reported also by this group as an activity in which they engaged. One person reported a single planning conference of about 40 minutes, while two colleagues reported between 2 and 5 conferences averaging 25 minutes each. Pre-observation conferences were conducted for all three student teachers; one student reported participating in one conference and two reported participating in between two and five conferences of 15 minutes each. Post-observation conferences were reported as well. Two students reported one post-observation conference each. One stated the conference lasted about 10 minutes, the other reported a conference of 30 minutes in length. One student reported over 5 conferences averaging 10 minutes in length. Midterm evaluation conferences occurred for two students, and averaged 15 minutes in length.

Two student teachers reported they would both recommend and use video conferencing again as part of their student teaching activities given the opportunity. One stated s/he might use it, reporting technical problems, need for more technical support, and problems using the equipment with students who had not used it previously. No further explanation was provided and no follow-up interview was conducted. Project directors do know this response came from one of the student teachers working with special education students; and, though not reported, it is believed the respondent is referring to concerns also expressed by the university supervisor (moving special education students to a new environment where video conferencing capability was available).

Student teachers agreed that use of video conferencing was positive because: (1) it made an otherwise unavailable site available; (2) it made it possible to be part of an innovative project; and, (3) of the collaborative nature of the Millcreek/IUP partnership. Two said it helped them develop skill in the use of video conferencing for future activities. At least one reported it: (1) made the university supervisor more available; (2) made possible the establishment of a definite schedule of observations; (3) made it possible to know the schedule of observations well in advance; and, (4) made the participant more comfortable with the use of technology as the project progressed.

Areas that could be improved were also noted by student teachers. All three reported the need for more preplanning for the entire experience. One student suggested a dry run or pre-training experience. Two student teachers thought the scheduling of observations and meetings needed to be improved and that there needed to be more preplanning for each observation. One student reported that the audio

quality needed to be improved. One student also reported s/he would like to see an increase in the number of observations.

The following data were collected using a Likert-type scale of 1 to 5 (1 is low and 5 is high). Overall, two student teachers rated effectiveness of using video conferencing as 2, one reported it as 4. All were very happy with the quality of the feedback they received from supervisors using video conferencing; one rated feedback as a 4 and two rated it as 5. All three student teachers report their overall satisfaction as 4.

Student teachers provided several additional comments. One student stated:

> "I appreciated being a part of this innovative project. If any further assistance is needed please feel free to contact me."

Another stated:

> "The video conferencing was great, however it would have been more effective if the students were not taken out of their usual lrg [learning] environment (especially special ed)."

Summary Statement:

Project directors learned a number of things to help modify the project. Although very preliminary, significant findings about what works suggest that:

1. Video conferencing for student teaching supervision is effective.
2. Video conferencing works across settings and disciplines.
3. With minimal preparation, students, cooperating teachers, and university supervisors are able to use video conferencing in the supervisory process.
4. Currently available technology is sufficient to provide effective supervision of student teachers in distant locations.

Information from Phase I of this project suggests:

1. For participants, involvement in an innovative project and the availability of an otherwise inaccessible site seem to outweigh the minor technical problems.
2. Equipment location should not dictate usage, especially for students who may have special learning needs.
3. There is a need for well-planned pre-training/orientation to the use of video conferencing for supervising student teachers.
4. Human aspects of planning, scheduling, and conferencing may be more important to the perceived quality of distant supervision than technical aspects of using the video conferencing equipment.

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Multiple Perceptions and Perspectives: Faculty/Students' Responses to Distance Learning

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Technology has dramatically changed the way people interact and communicate. Many educators have readily embraced the idea that technology will, to varying degrees, alter their teaching. Technology lets educators explore multiple delivery systems and varying means of communication between teachers and students. Research conducted during the past five decades found no significant difference in instruction offered in traditional classroom contexts and those offere by forms of remote transmission such as television (Russell, 1992).

The use of technological advances has been an easy accommodation for some educators. For others, this has not been the case. Any change or paradigm shift comes with attendant concerns and frustrations thus it is necessary for educators to look closely at the process as we engage in varying delivery and communication systems. Reflection on the teaching/learning process, then, is crucial. Richardson (1990), in calling for an "individualistic, psychoanalytic approach" to teacher education, recognizes that lack of reflection leads to "an idiosyncratic view of teachers. That is, the teacher teaches as he or she is. How then, are we to think about affecting change?"(p.13). In order to facilitate such change, reflection was an integral part of the course.

In Psychology of Personal Constructs, Kelly (1955) notes that people use experience to create constructs through which they create new experiences and then verify or modify other experiences. We build each experience, then, upon experiences that are, in turn, modified through future experiences. This process is one in which we view the participants as "explorers" investigating their own historical landscapes (Pope and Keen, 1981). Through this exploration of self and one's educative experiences, the educational context and perspective continually evolve. Kelly refers to this "permeability of constructs" as the working through ideas not rigidly held but open to change through new experiences.

Participants and Setting

The participants in this study were all pre-service graduate teacher education students at a large urban university. The participants were enrolled in a degree program leading to a Master's of Arts in Teaching. All of the students were "career-changers" who, after several years in various professions, were now pursuing careers in teaching. Formative and summative qualitative data was gathered on the expectations, experiences and impact of the distance learning component of this course on the participants.

Context

The University has several campuses within a forty-mile distance of each other. I was scheduled to teach a course entitled "Language and Meaning" during a six-week summer session on one of the University's campuses in Westchester, a suburb of New York City. Approximately two months before the beginning of the course, six students from the New York City campus requested that this course be offered on their campus too. Due to many factors, this was not possible. In trying to accommodate these six students, the idea of teaching the course via synchronous distance learning technology was borne.

When I was asked to consider this prospect, I was intrigued. I have always been interested in technology, and I try to be innovative in my teaching. Nevertheless, here I was, a relative newcomer to the University, teaching a new course for the first time, considering embarking on this new adventure. As a teacher educator, I felt that it was important to take risks and try new teaching strategies, and I believe that technology, increasingly, will play a role in the lives of my students, all of whom are future teachers. Knowing very little about the "mechanics" of distance learning, I agreed with the proviso that the New York City students would agree to meet with me at least twice during the six-week course.

Implementation and Discussion

The course was offered via an interactive two-way audio and video delivery system in which participants on each campus were able to view each other. I taught the course on-site in Westchester with real-time transmission to the New York City campus. I also set up an interactive web site in

the hope that this would facilitate communication between and among the students (Rhodes and Flank, 1998).

On the first day of class, I explained to the Westchester group what we were doing and why. The New York City group which had grown to ten students, knew about the distance learning situation. Many students in the Westchester group were uncomfortable with the prospect. They were concerned, confused and worried that they would not learn. We spent a great deal of time talking about the logistics of the course and the concerns of the students. We talked extensively about technology and its role in teaching and how this course could provide a demonstration of such a teaching/learning situation. We talked about taking risks as teachers and as learners. The students in New York City were much more comfortable with the situation, apparently recognizing that this was done to accommodate them. Three of the Westchester students seemed resentful and said that they might not have registered for the course if they knew that it was being offered this way. Although they were assured that they could drop the course with no penalty, they ultimately decided not to.

Initially, there were some problems with the transmission across locations. Initially there often seemed to be too much "down time" because the technological glitches interfered with the normal flow of a traditional class. Students at the remote site could not see things written on the chalkboard. Sometimes students could not hear each other. We forged on though. The interactive web site was active but only five students logged on during the first week.

Since this was a course for future teachers, we decided to focus not only on the content of the course but also on the process of being engaged in this distance learning situation. We explored the research on teachers as reflective practitioners as we navigated through the course. Students were asked to reflect on their experiences. I did too. After the first class I wrote:

I wonder about this experience . . . how will I ever manage this situation. I pride myself on knowing my students, but how am I ever going to get to know the NY group. They seem so remote— they are! This may not work for me. I've got to find a way to acclimate myself and my students. While I understand their discomfort, I hope that they realize that this will be a valid educational experience. Why are the Westchester students so uncomfortable? We've got to talk about this and relate it to their future professional lives. They too will be confronted with students who are angry or resentful or merely afraid. They need to see that this can be a great experience and their struggles will help them better define themselves as teachers. I need to help them.

After our second class, Kathryn and Paul, both Westchester students, decided to write their reflections on the web site rather than on paper. Most of the New York students discussed their feelings of being in a University setting which clearly was responsive to students' needs. During this first week, none of the New York students focused on the content of the course or on the technological aspects of the course.

Honestly, I wasn't sure after the first class, whether I would like the distance component to the class. I'm still not convinced but I think that this class went smoother and I don't feel as much like I'm going to miss out on the content because of the technology. I couldn't imagine myself taking a class by distance learning. As discussed at the end of the class, I feel that both the students and the teacher lose the personal contact and body language which I feel is invaluable in communication. I can see the value in a distance learning class, but I hope that it is not the wave of the future. (Kathryn-Westchester)

The jury is still out on the conferencing between the two campuses. So far it has worked out well for me, but I'm assuming that is because I'm in the class with the teacher. I feel strongly that conferencing is not the way to go in Education. There is just too much that students and teachers miss out on when they are not in the same room. How can we pick up on the body language? (Paul-Westchester)

By the second week of the course, we all became a bit more comfortable with the distance aspects of the course. Interestingly, some issues that arose out of the technological inclusions were interspersed within the course content. Students pondered language and meaning in varying contexts. They looked at various forms of communication, they questioned how people construct meaning and as they began to use the web site more, they pondered whether written communication was more meaningful than verbal communication. Often, the dilemmas posed by the technology formed the impetus for closer connections to the content of the course. The students began to look at the course as teachers rather than just as learners.

From a Westchester point of view, this is an interesting experiment to be a part of. I do not mind being a guinea pig from this perspective, and can personally put up with anything for a worthwhile common good. However, I still "feel sorry" for the NY people. I do not think they will get as much out of this class. I view them as "passive learners" - just like kids watching TV vs. being in a real hands-on learning situation with interpersonal feedback. They are listening, but are they tuned into the dynamic professor? They are not voluntarily responding, only responding when directly asked questions. It will be interesting to see if they become more active participants as the class progresses or not. Then again, maybe the NY people are happy being in a passive situation, where demands to participate are psychologically less, because they do not have the physical presence of the professor or eye contact with the prof to prompt them to respond. Some of them might be content

just sitting there anonymously, soaking up what information they choose. Others might be frustrated, but not express it, because they chose to be a part of this experiment and have put their money on the line to take this course. Also, some of them may not be responding, because they simply feel very self-conscious being on the TV screen or talking into the microphone, just as many people do not like their picture taken or voice recorded (Nadine-Westchester).

Just a few comments about the video hook up system we're using. It seems to force us to engage in "report talk" rather than "rapport talk" more typical of other classrooms. Sometimes it feels like I'm speaking over the PA system at Yankee Stadium. In N.Y., the fact that we each have to find the microphone, then turn it on, then interrupt the discussion in Westchester of course limits the spontaneity of our comments. As for the web site, this is a first for me. My initial thought as I sit here typing with one finger (typing is another of many skills that I don't have), is "What kind of communication is this?" I'm not talking- if I decide I don't like what I'm typing in, I can just change it before I send it, or can decide not to send it at all. So, there is not the spontaneity of speech, whether formal or informal. While I certainly don't feel the rigidity of paper-writing, I am aware of a permanence to the written word that isn't there with oral speech. I suppose this is somewhat like the long-lost art of letter-writing. There's an odd feeling of "Who is the audience?" When I talk, I know who I'm talking to and when I write I know who I'm writing for. Now, I'm just sort of writing to an uncertain audience; perhaps one or two, all or none of my classmates will read this, today, tomorrow, next week or never (Perry-NY).

I was feeling much more comfortable. The students were engaged in thoughtful discussions and we were better able to communicate across campuses. But, as I read Nadine's and other Westchester students' reflections, I realized that many of them were trying to figure out what it might be like to be on the receiving, rather than broadcast sight. I decided that experiencing both situations was important for them and I arranged to switch sites and broadcast from New York rather than Westchester. Again, the Westchester students expressed concern. However, we were able to discuss how this would enable them to more clearly see some pedagogical issues and more closely identify with their NY classmates. I ultimately taught on-site from New York three times during the six-week course.

It will be interesting to see the participation level of the NYers vs. the Westchester people, on the evening(s) when the roles are reversed. I believe youngsters, in general, especially those in grades K-8 would have less trouble and even eagerly embrace the concept of long-distance learning more readily than adults. These kids have grown up in a technology age (Diane-Westchester).

I happen to be enjoying this class very much. However, when you made the visit to the New York Campus for the day, I felt as if you were not part of the class or our professor. During that session the class seemed to be longer, more drawn out, and our attention spans were far less than the regular classes that occur with you present. As a result, I am very glad that I am on the Westchester campus, and I do feel for those on the New York campus, because I can understand how they can become annoyed when they cannot intervene on the spot, instead they have to pause and wait for the microphone, or if they cannot interact as they would like to. This class is one of a lot of action. (Shelly-Westchester)

As some of us anticipated, the unanimous feeling in Westchester was that we did not enjoy being on the opposite end of the camera and microphone. The consensus was that this was interesting to witness on a one-time basis, but "we want Carole back."(Nadine-Westchester)

I happened to enjoy the broadcast from the Big Apple. I was glad to get a chance to see it from "the other point of view." I know that some of you aren't comfortable with it but I think this experience is a valuable lesson that can be utilized in many ways. One thing I think we all should work on is giving NYC a chance to speak more. I commiserate with you all in NY regarding the "back burner" feeling that is sometimes felt while being on the receiving end. (Rick-Westchester)

As the semester progressed, the technological aspects of the course became secondary. Seven of the students from both campuses decided that they too, wanted to switch sites occasionally. They felt that they wanted to more fully engage in the experience and they also wanted to get to know their classmates more. We added a telephone linkup and were able to do inter-campus group work. With the exception of one student, ironically a New Yorker, all seemed to be at ease with the remote transmission and were readily able to move beyond the technology and focus more deeply on the content. By the fifth session, students on-line comments rarely dealt with issues of technology and mostly dealt with content specific issues. I wrote:

It feels like it's all coming together. The content of the course has always been intact, but the polarity of the two sites seems to be diminishing. People on both campuses have fused into one class. There is a cohesiveness, a bonding.

The students continually reflected on their experiences, focusing on themselves as learners and as future teachers. Except for one NY campus student, all reported positive feelings about having been involved in a distance learning situation, though more than two-thirds of the students did not feel that it was something that they would like to use in their teaching.

I do appreciate the opportunity of being in this class and experiencing distance learning first hand. I have become much more comfortable on the Internet and have gotten to know people on two campuses. The course stands

as a lesson to us all and I think we are all better for having been a part of it. (Alice-Westchester)

As part of their final project, the students were asked to reply to the topic "Where I was, where I am now?" Perry's reflections parallel those of most of the participants:

My final thoughts about distance learning: On the first night I was skeptical and considered surrendering, but I'm glad I hung in there. It was indeed an interesting experience. It remains undoubtedly preferable to be on site with the teacher. Because it extends a course's reach, allowing students to take those they otherwise might not be able to take, it's a positive development. It should lend itself well to lecture courses, not interactive courses like ours. Where am I? Much more enthused about technology and much less scared of it.

On the last night of class, we all met in a restaurant midway between both campuses. While several students had transversed campuses and therefore met each other, many of them had not. Over dinner, the conversations centered on typical topics, but interspersed were discussions of connecting with a teacher, limitations of technology, teaching and learning and the desire to continue to relate to each other.

Conclusions

Analysis of the formative and summative data gathered from the participants reveals key themes and issues including: the need for interaction among students; the need for student-teacher interaction, pedagogical concerns of distance learning courses; the impact of interactive-web sites in education and the role of reflection on one's learning.

Overall, most of the students indicated that they had never reflected on their own educative experiences. They noted that while doing so now, they learned about themselves in ways they had not thought about before. Most of the participants noted increased self-understanding. Many participants noted that they were better able to get in touch with their own learning processes.

One outcome of this research is to encourage teachers to reflect on their educative experiences as a way of better understanding their classroom practices. A second outcome is the generation of questions about the effective incorporation of distance learning.

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A Case-Based Electronic Learning Environment for Preservice Teacher Education

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This study took place within a teacher education program at a large Midwestern university with vast field observation placements around the state and world. In the first field experience of this program, preservice teachers study for 20 hours with nearby public school teachers. Here, students experience varying degrees of isolation from their instructors, cooperating teachers, and peers. Not surprisingly, many students are lonely and unsure of their responsibilities, while cooperating teachers only have a vague idea of what is expected of the visiting student. Fortunately, as Singletary and Anderson (1995) point out, there are a number of emerging computer conferencing technologies to support beginning and inexperienced teachers with specialized training and consultation.

The purpose of this study, therefore, was to discover whether preservice teacher electronic conferencing on the World Wide Web (WWW) about early field experiences can have an impact on their learning of educational psychology and general apprenticeship within the teacher education program. In building on an earlier comparison study of synchronous and asynchronous conferencing, favoring the latter, this follow-up second experiment was conducted in the spring of 1997 using student-generated cases and an asynchronous web-based conferencing tool called Conferencing on the Web (COW). In a nutshell, this study combines the power of asynchronous conferencing with case-based reasoning and peer and mentor collaboration to electronically apprentice student learning.

Technology Meets Learning Theory

Cases have been used in law, medicine, and business to ground student learning into the context of these disciplines (Riesbeck, 1996). According to Williams (1992), the case method has been used to anchor classroom activities in complex situations wherein students can reflect on the utility of knowledge while understanding the conditions of use. However, she also points out that cases can vary in their authenticity, complexity, engagement, and underlying format. In terms of format, cases can be presented as simple narratives, cases with embedded flaws, cases with expert commentaries, and cases with alternative or counter cases (Silverman, Welty, & Lyon, 1992).

According to Copeland (1989), technology-mediated laboratory experiences might enhance the level of preservice teacher reflection and clinical reasoning about such cases. The time independence of asynchronous web-based conferencing tools, for instance, now offers students opportunities to evaluate, summarize, and communicate critical information about a case situation or problem. Recent developments on the WWW have made available cheap, fast, and broad opportunities for preservice teacher case reflection as well as potential access to expert teachers and mentors. Using the web, college instructors, therefore, might apprentice preservice teacher learning by modeling expert-like answers, providing feedback on student misconceptions, and offering key instructional help and task structuring. Electronic cases might also allow preservice teachers to jointly construct new knowledge with distant peers under the tutelage real-world practitioners (Riesbeck, 1996).

As Singletary and Anderson (1995) state, there are a number of emerging computer conferencing technologies to support beginning and inexperienced teachers with specialized training and consultation. Web-based conferencing (WBC) allows users to read, browse, and add to multiple discussions by using a web browser anywhere in the world. Hence, one does not need access to networks or systems at a particular university to participate in an electronic discussion. All that is needed is access to the WWW and conference clearance from the conference moderator. Another benefit of WBC is that discussions occur asynchronously, permitting the user to read, browse, or add to them at his or her convenience.

Most research on the use of collaborative educational technologies in higher education fails to provide extensive theoretical grounding (Koschmann, 1994). Moreover, faculty and public school teachers sorely lack important information about the effects of various tools and how to embed them in their classes. As a result, some researchers turned to sociocultural theory (Vygotsky, 1986) to evaluate and understand electronic learning environments. Though sociocultural theory continues to evolve (Wertsch, 1985), few studies focus on how sociocultural variables impact adult learning and problem solving (Forman & McPhail, 1993). One sociocultural concern in electronic learning environments is what forms of learning assistance (e.g., modeling, questioning, task structuring, feedback, and scaffolding, see Collins, Brown, & Newman, 1989; Teles, 1993) are evident in electronic computer conferences. Another variable of interest relates to how meaning is negotiated and common knowledge acquired (Rogoff, 1990). A third crucial sociocultural issue is how experts or practitioners cognitively apprentice novice learners in developing skill through authentic learning experiences or exposure to cultural practices (Lave, 1991).

Research Questions

The following research questions were examined:

Dialogue

What topics spur discussion? How does peer responsiveness affect the depth of dialogue? How is intersubjectivity displayed?

Requests for help/Learning assistance

How do students ask for and receive help? What types of advice and learning assistance (i.e., questioning, feedback) do peers, cooperating teachers, and instructors provide in this web-based conference?

Scaffolding and apprenticeship

What might be the indicators or signals of effective mentoring on the web? How might apprenticeship and emerging expertise be captured electronically?

Attitudes

What are the students' attitudes toward using computer conferencing within their early field experience? Will they prefer heavy or weak scaffolded discussion?

Teaching philosophy

Will using conferencing tools foster new expectations of teaching and learning?

Research Methods

Subjects and Intervention

During the academic year of 1996-1997, 146 undergraduate educational psychology students were randomly assigned to two different electronic conferencing groups, one group was heavily scaffolded and the other was not. When in a strong scaffolding conference, students received more task structuring, instructor guidance and feedback, moderator queries, and cooperative teacher recommendations. When in a weak scaffolding conference, students received feedback from their peers, and, when they requested it, help from the instructor. Each student was asked to generate two problematic teaching cases based on his or her observations in the field, as well as provide plausible case resolutions based on readings and lectures. Students were also asked to give feedback to at least four peers on their cases and summarize the electronic discussion generated by his or her respective case as well as at least one peer's case. After three weeks the students who received heavy scaffolding were assigned to another conference where they received weak scaffolding. Along the same lines, the students who received weak scaffolding during the first three weeks, were assigned to a conference where they received strong scaffolding. Such counterbalanced research design was important to control for the effects of system familiarity and utility.

Conferencing Technology

The WBC tool used here is called Conferencing on the Web (COW). COW is organized into three basic levels. At the base level is the conference level. While this is typically a single class, the four conferences reported later on in this paper each consisted of students from five different sections of undergraduate educational psychology. Conferences can be public (i.e., needing only a COW account) or private (i.e., needing permission of the conference moderator or "fair witness" to view). At the second level of COW, each conference is organized into topics (e.g., lecture-based questions or issues). Topics are typically listed at the bottom of the conference main page. At the third level of COW are conversations between students and instructors in response to the material presented in class. Most electronic conferencing actually occurs at the conversation level wherein new messages are posted below older messages. Anyone permitted to join a COW conference can start conversations or reply to conversations here.

Data and Instruments

All of COW case discussions and conferencing activities were saved and archived for in-depth analysis. Aggregate conference posting data was printed out after the conferences ended. In addition, a sample of 60 case discussion threads were analyzed for dialogue content, case quality, and forms of mentoring. Exemplary instances of individual commenting were noted. Finally, after the conferences ended, three of the five course sections took a five minute survey about their attitudes toward the conferencing activity.

Quantitative Analysis

As indicated, the WBC system automatically provided extensive empirical data regarding system usage. This information included: (1) the number of people who

accessed the system and who actively contributed; (2) the overall number of messages and length of message posted to COW; (3) the number and length of responses in the HS and WS conditions; and (4) the average length of a case, case threads, and case summaries.

Qualitative Analysis

Qualitative data were combined with the above quantitative data to build a chain of evidence about the collaborative formats and interaction patterns that facilitate student learning and reflection on the web. Student electronic transcript conversations were coded for discourse type, case components, case summary components, question type, and the forms of learning assistance and mentoring (Tharp & Gallimore, 1988). After the semester ended, a stratified random sample of 35 HS and 25 WS cases or electronic discussion topic threads representing a wide range of discussion and response depth were chosen for content analysis (e.g., Bonk, Hansen, Grabner, Lazar, & Mirabelli, in press; Henri, 1992). Two of the sixty threads were found to be repetitions or extensions of other cases and were removed from the analysis.

Besides recording the components of a typical case and case summary, the content analysis scheme chosen recorded the following forms of electronic discourse: (1) social acknowledgments; (2) unsupported claims and opinions; (3) justified comments; (4) questions and dialogue extension prompts raised; and (5) mentor scaffolding. From these data, we attempted to determine the types of conferencing structures and instructional scaffolding that promoted more extensive dialogue and debate. The key variables of interest here were the depth of dialogue, references to classroom resources, instances of intersubjectivity, and general peer responsiveness.

Discussion of Results

There were a myriad of interesting findings in this study of asynchronous web-based conferencing. First of all, with 1,549 (229 cases and 1,320 replies to them) student case-based postings, it can be argued that students were heavily involved in electronic writing during this six week period. Writing was a way for students to clarify their thinking about field observations and the text material. The electronic traffic registered indicated that the system functioned as planned; while all case conversations were logged and stored for later analysis, the user friendly COW system did not interfere with student case discussions. In over 1,500 postings, students were sharing stories and were apprenticed into teacher education by expert mentors and peers. COW training was so easy, in fact, that immediately after their training students were observed writing new cases as well as firing off responses to the cases of their peers. Since the computer laboratory could accommodate 25-30 students for training, there were times the COW conferencing took on a synchronous flavor.

Other positive results included the fact that groups involved in teacher education (i.e., students, instructors, and cooperating teachers) were communicating with each other through an electronic conferencing tool that was fresh and exciting. In this electronic conferencing system, students were sharing problems and events, asking for help, offering advice, and sharing related stories and events in their lives. To consistently receive five or six responses to a teaching related problem or dilemma one observes in the field is remarkable. In effect, students were conversing about their real problems that they may soon have to face and receive timely and candid feedback. The electronic conference was also a place for extensive social acknowledgment and support. Hence, despite survey data to the contrary, the initial goal of the teacher education program was met with some success—students were not so isolated from their peers and teachers when observing in the field.

Though case quality scores were not related to the depth of electronic discussion, students were reflecting on their field observations in an electronic "shared space" (Schrage, 1990). Instead of case quality or length, case description and topic appears to draw students and mentors into an electronic discussion. Naturally, currently "hot" topics were major draws for such case-based dialogue. Another enticement was that students were not afraid to request help in solving or addressing their dilemmas. Even with all these requests, mentors seldom replied to student questions and concerns with direct instruction. In effect, teachers electronically scaffolded or apprenticed learning without giving away answers. In summary, then, most cases encouraged responses by having interesting contexts and problems, student solicitations for help, and general receptivity to feedback.

Despite these positive findings, there were a myriad of concerns as well. First of all, a twenty percent reduction in the number of mentor and student postings during the second three week period may indicate a drop in interest in sharing field experience information with one's peers and teachers. Perhaps the novelty of COW may have wore off. This decline in participation may also reflect a decrease in time for such activities late in the semester. At the same time, the latter three week cases and discussion threads were longer than the first three weeks, indicating that, while the shear volume of postings decreased over time, students became more thoughtful and elaborate in their responding.

Another interesting finding across all conferences and conditions, was that case threads averaged between five to seven postings. Such a consistent average could reflect the number of users in these conferences, the time allotted, message scrolling frustrations, or a feeling that a half dozen responses was sufficient. More research may be needed here to sort this out.

It was also difficult to explain why students generated more cases when in the HS condition, while creating cases

of significantly higher quality in the WS condition. Perhaps students in HS took advantage of mentor feedback and submitted a myriad of problems for which they expected advice, while the WS condition fostered a more laid back atmosphere and complete case submissions. More analyses are clearly needed here.

A less surprising finding, though also disappointing, was that few student electronic responses to these cases were grounded or justified in course material. While students documented 229 real-life cases of the classroom teacher and introduced a wealth of intriguing topics for discussion, they, for the most part, failed to generate and evaluate cases that were grounded in educational psychology theory and concepts. And while students were observed opening their textbook more during the second three week conference, such direct course linkages were, nevertheless, scarce. Not only were direct links to text and class resources extremely limited, few student responses were controversial in nature. Too many simplistic and naive ideas and remarks were responded to with an "I agree" from a peer. Though students tended to ignore some of the case structure, one possible recommendation for fostering critical thought is to force students to back up each point made with a concept and page reference from their textbook. In effect, students need to be more explicit about their connections. Equally important, there is also a need to foster more disagreements and counterassertions such as through role assignment (e.g., watchdog, pessimist, debater, warrior, idea squelcher, and devil's advocate) or electronic debates.

There were also a few problems involving both preservice and inservice teachers in the same study. Despite conference moderator assurances to the contrary, some students were extremely concerned that their comments would be accessed by the teachers they were observing. In fact, since students were observing in most local schools, we were limited in the cooperating teachers we could include in this project. Expert teacher feedback, therefore, became difficult to arrange for and more limited than originally intended.

While students found COW to be an easy conferencing tool to use, many of them looked at this as an additional task burden of their class, not as an opportunity to interact with their peers. The mechanical nature of the case creation assignment limited opportunities for spontaneous learning and risk taking. While off-task behaviors were virtually nil and students were unaware of the volume of written text they were producing (as in the original study), they did not seem to be having fun writing. Students, wanting grades and points, were task, not mastery, driven. As a result, there was no real sense of learning community felt here. Perhaps the three week time period for each set of conferences was too restrictive. Often times mentors would provide feedback and scaffolding at the end of the three week period and students would not realize that there were additional comments to read. Not surprisingly, many students did not appreciate the mentoring.

Contributing to the lack of an electronic learning community was that many comments from mentors were of an authoritarian or vertical nature, not collegial. Of course, it is a difficult situation for mentors to simultaneously suggest various course connections and real-world examples, while trying not to act as purveyors of knowledge. Moreover, with one to two postings from mentors per case, the term "heavy scaffolding" may be a misnomer. Perhaps, in the future, such "modest" scaffolding might be compared to more extensive scaffolding.

Conclusions

In an earlier study, delayed collaboration and real-time case fostered completely different social interaction and dialogue patterns. Notably, asynchronous cases were more productive in terms of student engagement in the learning process and overall responsiveness. Students in the delayed mode challenged and encouraged each other to think more deeply about educational issues and problems. The real-time focus, on the other hand, was on content generation, not on extended peer interaction and dialogue.

In this follow-up study, students once again appeared task focused. Perhaps student and teacher interviews in the upcoming third study will help us build electronic supports that foster more intrinsic learning opportunities and electronic cognitive apprenticeships, thereby helping advance research in computer-mediated communication from a sociocultural perspective. We concur with Owston (1997, p. 33) who notes that, "No doubt further research and development on the application of the Web to teaching and learning is needed." Based on the initial work here, the WWW may soon become used in a myriad of preservice teaching activities. As a result of this research, we are beginning to understand how preservice teachers remote from the university setting can communicate with their instructors, peers, and cooperating teachers regardless of distance or time.

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TEACHERNET: ON-LINE K-12 CLASSROOMS NOW READY FOR ON-LINE STUDENT TEACHERS

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Since 1989, hundreds of student teachers have participated in the TeacherNet telecommunications project. Many have formed a cadre of technology using educators that still communicate and support one another through the beginning years of teaching. No longer isolated in the classroom, they now have the information resources of the Internet and the community support of peers to rely on during their teaching. It is hoped that this support will help reduce the teacher retention problem.

The major benefits to telecommunications during student teaching have been found to be the following:

1. Increased reflectivity - Student teachers reported increased time to reflect on what they were learning, including teaching approaches and decision making. Use of e-mail writing helped foster probing to promote deep understanding of teaching, to engage in a written conversation about experiences associated with their making meaning of teaching.
2. Increased feeling of rapport and support from university supervisor, access to other supervisors and university personnel.
3. Increased team support, decreased feelings of isolation. Perhaps one of the most notable outcomes of the e-mail approach is the immediacy with which students can establish contact with the university supervisor or their peers or master teacher. No longer do they have to call for an appointment or wait until the next seminar class to address concerns, questions, or ideas.
4. Increased self-esteem due to mastering technology and receiving positive support through e-mail messages, increased pride from the professional documents they could create at home.
5. Increased knowledge and use of information access and retrieval as well as various types of technology, such as multi-media. Great enthusiasm on finding wonderful classrooms resources on the Internet by themselves.
6. Increased use of the computer at home for personal and professional work and in the classroom when teaching.

Today and Tomorrow

One of the problems of the initial studies was the expense and management of providing students with loaner computers. Also, the early communication networks posed access problems.

Fortunately now in 1997, many more student have their own computers at home. In order to have students ready for TeacherNet as soon as they begin student teaching, this semester I have required them to get a free university account during my methods course prior to student teaching. 90 students have been on-line and communicating lesson plans with me all semester, on their own or university computers (no loaners required). This new cadre of students will come to student teaching as knowledgeable computer users.

Finally, this Fall some of the elementary school field sites we use will have telecommunication in the classrooms. This will allow us to close the loop and have methods students working with K-12 students and teachers and university professors on-line.

Expanding classroom contact to global sites where classrooms can be working on collaborative projects of interest to students in cooperating countries around the world is the other element we will put in place in Fall 98.

Change in the Classrooms

The university reading methods students have been trained to use the Internet in finding teaching resources; they have been using e-mail for communications with university professors and peer teachers; and now they are working with K-8 students in the classrooms. They serve as a model of the classroom teacher as they demonstrate to the K-8 students how to use e-mail, how to communicate with global penpals and how to find information on the Internet.

The student teachers working in schools that have just been wired for the Internet are an important resource, coming to the classroom with on-line skills, these new teachers lead the way by working side by side with other teachers and helping them acquire the necessary skills for information evaluation and retrieval to use in their classrooms and to model for their students. The embracing of

technology in every school classroom has been a very slow process; schools were resistant to any innovation that massively changed the existing structure of schooling. At first computers were only accepted into the schools in lab settings. However, as the information society has exploded in the outside world and realization has occurred that one hour a week in a computer lab does not prepare students effectively for the technology they will need in the workplace, schools have slowly begun to place computers, moving one to six networked stations into the classroom. The national goal is to have all classrooms wired by the year 2000 and with only a couple years remaining to accomplish this goal, suddenly school districts are implementing this idea and wiring up the classrooms. However, that is only the first step. There are large numbers of classroom teachers who still are not comfortable using the computer for themselves, let alone supporting and facilitating computer use for their students. Districts often save money by excluding teacher technology training packages, and knowledgeable technology teachers are still a great need in our schools.

The university provides a partial solution by making sure that all new teachers come to the schools knowledgeable about on-line communications and Internet resources. It is vital that they understand and convey to their students not only where to locate information, but then the harder task of evaluating the value of the many resources that exist and using the most pertinent and accurate information in the classroom.

Summary

At California State University, Long Beach, we have harnessed the Internet as a step toward easing the anxiety of student teachers and reducing the numbers who drop out of the profession in their early years. TeacherNet allows student teachers to keep in touch both with their colleagues and professors, giving them quick access to ideas for the classroom as well as to emotional support via e-mail that lets them know they are not alone in running into instructional or classroom management problems.

With elementary classrooms nationwide getting wired for the Internet, the program has taken off and provides numerous benefits to everyone concerned. A supervising professor can observe a student teacher giving a lesson and-rather than attempting a quick debriefing before rushing off to the next observation-can reflect on the lesson later in the day and communicate by e-mail during evening hours. Student teachers can prepare lesson plans in advance and send them off for review and comment by both the master teacher and the university supervisor before delivering them.

Research shows our graduates are computer-using educators in their classrooms. The Teacher Education program at California State University Long Beach, is one of the largest in the state with 60 members and ties to almost 50 school districts in Southern California.

But as important, student teachers communicate with one another, creating a peer support network. They can ask each other about what might work in the classroom-when, for example, someone is stumped about explaining pulleys while three students goof off in the corner-as well as find out they aren't the first student teachers to harbor thoughts about chucking a career still-born.

The days are gone when a student teacher has to wait for an appointment or meeting of colleagues to address concerns. "Technology is not the be-all and end-all," Casey says. "But it is a useful tool...we are in the infancy of something that can really change our educational world." And that means the student teachers will remain as teachers, too.

This year was the beginning of the final and most exciting step yet for TeacherNet, we now are not just linking pre-service teachers and university supervisors but we have expanded the web to include in-service teachers and most important the entire K-8 elementary population that will now have classroom access to the Internet for global communications and information resources. In order to assure that the technology is used wisely and effectively all these partners need to be communicating with one another and spreading the wealth of information among all the educational institutions from home to university with the one major goal of educating the child to be an effective adult in the information age. Three year old Katie Casey wrote her first letter to Santa Claus on the Internet, she was pictured in a Washington Post story, as she composed the letter. When she is ready to enter the classroom door will the teachers be there who are trained and ready to continue Katie's education by supporting her on-line knowledge? That is our challenge and together we need to make it happen.

Related Websites

Global education website: http://www.kc.kuleuven.ac.be/esp/

TeacherNet Web Site CSULB: http://www.csulb.edu/~jmcasey/

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Teachers Telementoring Preservice Teachers in a Collaborative Environment

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Current NCATE/ISTE standards (ISTE, 1997) require that students have a working knowledge of telecommunications and its use in the classroom. The Task Force on Technology and Teacher Education has recommended to the National Council for Accreditation of Teacher Education (NCATE) that technology be emphasized as central to teacher preparation in the 2000 NCATE accreditation standards. Future teachers learn from what they observe during their field or internship experiences in the P-12 schools (NCATE, 1997). They must see technology modeled by college methods instructors as well as by P-12 teachers during their practica experiences.

The State of Illinois and NCATE standards both recommend more field based training such as Professional Development Schools for preservice teachers. Increased field placement is difficult given the 1300 elementary education students enrolled at Illinois State University. This research explores the possibility of whether an electronic connection utilizing Telementoring can provide an enhancement to the current initial field experience. It also looks at whether an electronic collaborative environment can provide an opportunity for students to put the theory and research from a Language Arts Methods class into practice during field experience and student teaching.

Telementoring is the mentoring of a group of novices through telecommunications by an individual or group of practitioners (Wighton, 1993). In this research, it refers to the mentoring of preservice teachers over the Internet by an individual teacher or group of current teachers.

Much of the research that has been done with Computer Mediation Communications (CMC) has taken place on a text-based environment such as a listserv or newsgroup or through the use of e-mail (Dobson, 1997; Tannehill & LaMaster, 1996; & Weiss, 1997). Tannehill & LaMaster (1996) present a summary of the research findings on the benefits of mentoring using e-mail as a supplement to classroom communications and as a facilitator of collaborative opportunities. They further discuss the research in teacher education as a way to maintain communications between teachers and university faculty and to support student teachers.

Video connections between schools and universities for collaboration are beginning to be reported. Two-way interactive video was used in Texas (Cifuentes, Sivo, & Reynolds, 1997) to provide a virtual field-based experience for preservice teachers. Inservice and preservice teachers collaborated to develop materials that supported thematic units. Both groups generally found the interactive videoconferencing partnerships to be rewarding with some reservations. At the current time videoconferencing either requires expensive equipment or requires extensive bandwidth over the Web. NetWorkPlace adds an inexpensive visual component that avoids the limitations imposed by video formats.

This research adds a visual component to a newsgroup type discussion structure to increase the ease of use. NetWorkPlace provides a visual metaphor of a building as a place for preservice teachers and mentor teachers to meet and discuss theoretical and practical educational issues. The location for this research is Floor 5 of the building (http://gallen.ncsa.uiuc.edu:5152/html /floor5/lobby/index.html). Each floor provides an informal discussion area located by the Water Cooler, three threaded discussion areas and three chat rooms designated as Conference Rooms, an Office with a database of participant information, and a Library for resource files. NetWorkPlace was developed at the National Center for SuperComputing Applications (NCSA) in Urbana and is being tested as a visual environment. Other collaborative environments are currently being researched by NCSA and may be used in future research.

Methodology

Participants

During Fall Semester 1997, inservice and preservice teachers used an on-line collaborative environment for mentoring activities. All participating mentoring teachers teach in one of four district elementary schools or teach language arts at the junior high school. The inservice teachers were enrolled in a Language Arts and Technology

graduate class taught by the researcher. The tuition for all teachers was being paid by a Goals 2000 grant. The class was being offered after school in one of the district computer labs. All teachers were required to apply to the district to be selected for the class. All teachers had e-mail addresses and direct connections to the Internet in their classrooms. All schools had LCD Panels available for teacher use. Video output cards had been purchased for all classrooms but were not installed during the semester. These teachers are serving as mentor teachers for preservice teachers enrolled in a section of C&I 256 Teaching Language Arts in the Elementary School, also taught by the researcher. Seventy-four percent of the preservice teachers in the study had e-mail addresses prior to class. The remaining 26 percent obtained e-mail addresses as a class requirement. All participating teachers had e-mail address at the beginning of the project.

Data

An initial questionnaire was administered to both groups to determine their level of experience with technology including the World Wide Web. A five point Likert scale was used to rate experience ranging from 1 (have taught) to 5 (have never used). Table 1 shows the number of participants in each category for World Wide Web experience. A question about the effectiveness of NetWorkPlace was included on the posttest questionnaire administered to both groups.

Table 1.
Experience on the World Wide Web

	Most				None
	1	2	3	4	5
Preservice teachers	0	48	22	26	4
Inservice teachers	6	31	26	19	3

Data were collected through process journals from both preservice and inservice teachers. Data were also collected from interactions on NetWorkPlace and from interviews from a sampling of both groups.

Procedure

Preservice teachers and inservice teachers were provided training on beginning and advanced e-mail skills and World Wide Web search engines as part of their classes. NetWorkPlace was demonstrated and participants were initially given class time to post or respond to messages. Preservice teachers were required to post a question related to a class topic that they had chosen to research. They could also post additional questions that arose during the semester. Mentoring teachers were to respond to questions from the preservice teachers and post further questions to invoke problem solving and theory application by the preservice teachers. Both groups were given some class time during the semester to post and respond to questions.

Results and Discussion

A discussion from NetWorkPlace is presented first as a sample of the questions and responses posted in the collaborative discussion environment. Data from the posttest questionnaires and qualitative data from teacher and preservice teacher journals is presented. This is a preliminary report of research conducted Fall Semester 1997.

The most discussed NetWorkPlace topic was classroom management. From the researcher's past experience with preliminary field experiences, this is one of the most difficult to teach in the university classroom and may be one of the most beneficial topics to receive input from actual teachers. Two preservice teachers asked teachers what types of management techniques that they use in their classrooms. Responses were posted by a Learning Disabilities teacher, a fifth grade teacher, two primary teachers, a junior high teacher, and a gifted teacher. An example of responses that reflected conflicting methodology and provided a basis for classroom discussion follows.

This statement is from a gifted teacher:

> My philosophy of classroom management is that my primary goal is to help my students develop self-discipline and a sense of responsibility for their actions and their learning, to behave in acceptable ways because they want to, not because they have to. I emphasize that we are a 'community of learners" working together in our classroom. Students are encouraged and sometimes assigned to work together on classroom projects and problem-solving activities.
>
> "Put-downs" are not allowed. Students may disagree with each other and the teacher, but must do it in a polite way. If I have a student acting in an unacceptable way, often just a look or a light touch will produce a change for the better in the behavior. If not, I say something such as "You seem to be having a problem. Can you handle it or do you need my help?" Usually they choose to handle it themselves. I never give rewards for good behavior but occasionally will remind students of such things as "The reason we are able to take field trips is that you behave appropriately and learn things on our trips."

A pair of primary teachers advocated a different approach:

> We believe that classroom management is an ongoing process. You constantly re-evaluate the mechanics of your students and room. We move the classroom around frequently to enhance student learning. Group activities are established depending on the age group and the needs of students. Positive

reinforcements almost always seem to work. Some positive reinforcements used are pats on the back, candy, a verbal praise, stickers, time with the teacher, extra computer time, free choice coupons. Students do need to know what you expect from them.

The following summary of preservice and inservice teacher comments taken from the journals of both groups includes both the perceived benefits and limitations of their NetWorkPlace participation. Twenty-three preservice and twenty inservice teachers responded to the request to evaluate NetWorkPlace in their journals. The most frequently reported benefit to preservice teachers (9) were related to appreciating responses from experienced teachers such as the following: "I liked talking to real teachers and hearing their comments and experiences". The most frequently reported benefit to inservice teachers (15) was feeling that they could provide guidance to future teachers. An example of teacher comments include the following: "I feel that NetWorkPlace is an excellent way for undergraduate students to learn from experienced and seasoned teachers. It's on thing to read about something in a textbook, but can be (a) totally different thing in the field." Nine teachers reported enjoying the experience while two had mixed feelings.

The most negative comments from preservice teachers, (10) were related to the difference between anticipated response time and actual response time such as the following: "Difficult to get a quick response so I lost my excitement". Since teachers could choose the questions to answer, some students did not receive answers to their questions. Five students commented on not receiving answers.

The most frequently reported limitation from inservice teachers (6) was the time required to respond to posted questions. The researcher used class time on three occasions for discussion groups and posting of responses. "While I think this (NetWorkPlace) has merit as a learning tool for undergraduate students, I was disappointed that so much of our class time was spent on it. I would have liked to have had much more time to work with HyperStudio."

There were two preservice teacher comments that NetWorkPlace was easy to use while one person would have liked a printed handout with instructions for using NetWorkPlace. Three inservice teachers commented on the ease of use and there were no negative comments.

The only problem observed by the researcher was that initially a few teachers and preservice teachers complained that the length of their responses was limited. The researcher determined that they were attempting to type the response into the question box rather than clicking the "Add response" button, which was below the display area of the screen. Once this was pointed out and demonstrated no other problems with the interface were reported. This ease of use is in contrast to technical difficulties and time required to learn an environment still reported by other telecommunications researchers (Powers, 1997).

Both groups made suggestions to improve the effectiveness of the collaborative environment. The most suggestions related to building virtual community between individual or small groups. Nine preservice teacher suggestions related to community building as did six inservice teacher responses. Sample suggestions from preservice teachers include the following: "Assign one or two teachers to a student so that all questions are answered." "More prior knowledge about teachers would be helpful. Maybe set up a meeting to 'get to know' each other." Sample responses from teachers included the following: "I would have liked to try communicating back and forth with the same student so a relationship could be started." "I would have liked to have been able to have a more sustained dialog with a student or students rather than just posting a reply or a question to the group in general."

On the posttest, participants were asked to rate the usefulness of NetWorkPlace. Table 2 shows the results.

Table 2.
Usefulness of NetWorkPlace

	Very useful				Not useful	Average
Preservice teachers	2	0	10	9	2	2.52
Inservice teachers	1	2	8	11	6	2.41

Implications for Future Study

While there were many positive comments and suggestions about the use of NetWorkPlace, preservice and inservice teachers rated its usefulness only as 2.53 and 2.41 respectively on a five point Likert scale. The following factors should be considered in designing future research on telementoring of preservice teachers.

During this study, all participants were required to participate in the collaboration as part of their class assignments. Other collaborative researchers report alternate methods for selection of teacher mentors. Norton and Sprague (1997) used an application process to select inservice teachers to mentor undergraduates enrolled in an introductory educational technology class. Johnson (1997) recruited mentoring teachers for an undergraduate reading methods class from an educational listserv. Future research is needed to determine how to maximize the different selection methods most effectively.

Ideas for motivating teachers to participate need to be further researched. Several possibilities were suggested by the current study. Inservice teachers participating in this study reported time to search the Web as a major limitation for the integration of Internet into the elementary classroom. Preservice teachers could search Internet for websites for paired inservice teachers to use in classroom units. Inservice

teachers could have a separate conference room on NetWorkPlace to network with teachers from other districts to share resources and ideas. One inservice teacher suggested college credit as a motivation for recruiting mentoring teachers.

The discussion group format needs community building between participating individuals or groups to make it more effective. Possible suggestions for building community include pairing individuals or creating small groups which include both preservice and inservice individuals. More research needs to be done on the effect of including desktop videoconferencing or an actual face-to-face meeting.

The researcher will use a collaborative environment Spring Semester 1998 between preservice teachers and inservice teachers who volunteer to participate. Fall Semester 1998 it will again be possible to link graduate classes and an undergraduate class taught by the researcher to continue this research.

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An Internet-Based Journal for Professional Development

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Donald Schon (Schon, 1983) in his seminal book on professionals as reflective practitioners described professional practice as a reflective conversation with an uncertain situation, taking stances, experimenting, and learning from the back-talk of the situation. Beginners in a field need opportunities to practice this reflective conversation and to make sense of the back-talk. Professional preparation programs address this need by having novices learn from field experience or through exposure to various representations of realistic experience, such as simulations, problem-based learning, or cases. The key to learning, however, is not in the exposure, but in the "reflective conversation" and the meaning that the student draws from the experience.

Introduction

Believing in the importance of learning from field experience and valuing the development of reflective practitioners has led the College of Education (COE), University of Missouri-Columbia to reform its undergraduate teacher education program. A fundamental learning process of the new program is (1) for students to experience teaching through observation or practice in schools and (2) to articulate the meaning they derive from the experience (a first level of reflection), (3) for faculty and experienced teachers to provide feedback and counsel so as to shape and enhance the "meanings" (a second level of reflection), and (4) for the body of experiences and "meanings" to grow and evolve through the undergraduate program and continue as professional development in the early years of teaching (a possible third level of reflection). A goal of the reformed teacher education program was to implement this learning process across the entire curriculum of teacher preparation and not just as a culminating student teaching experience or as a few aiding or observation opportunities. This goal required new forms of support for teaching and learning.

Concurrent with the curriculum redesign was an effort to use technology in the service of the new program implementation and in the development of technology using teachers. A technology infrastructure (Laffey, Musser, & Wedman, 1998) was designed and implemented that includes an emphasis on developing competency with technology for students, powerbook computers for all faculty and students, and substantial enhancements to network services. A significant component of the technology infrastructure was the design of an interactive shared journal system (ISJS) to facilitate the reflective learning process from field experience (Laffey & Musser, 1996). In addition to supporting the learning process enumerated above ISJS afforded students and faculty the opportunity to communicate with multi-media representations of experience, communicate both asynchronously and synchronously (via chat), and have access to a community knowledge-base of experiences from anywhere they could establish an internet connection.

Interactive Shared Journal System (ISJS)

ISJS was designed, developed, and implemented to support the representation and sharing services of the new reflective learning process from field experience. ISJS is implemented on a Macintosh client and Silicon Graphics Indy servers. The clients and servers communicate over the internet using TCP/IP connections. Anyone who has access to the internet via a direct connection or a SLIP or PPP connection is able to participate; thus students can connect from any home or school location in Missouri and beyond. In addition, the software supports the creation and editing of journal entries off-line for later upload when a connection is available. A custom server was created for connecting and maintaining a login to the journal system. The server provides communication between the client and an Oracle database. ISJS is a flexible system for the development and support of learning communities, but in the context of the undergraduate teacher development program it can best be understood as enabling three key processes: access to Internet-based resources, capturing experiences, and sharing experiences. These processes are undertaken in the context of a community made up of four roles:

- administrators, who are responsible for the system;
- mentors, who are responsible for instruction and modeling;
- students, who are responsible for articulation of experiences; and
- guests, who have limited access to public information

ISJS includes facility for:

- creating multi-media journal entries that can link to other entries or web sites,
- appending notes and comments to a journal entry,
- determining access and privacy levels,
- a flexible teaming structure
- faculty-created tasks (assignments) that can be distributed into student journals and then monitored for progress,
- user profiles to support access and sharing,
- system-based email, and
- real-time chat.

Logging into ISJS requires an id and password to connect to the intranet of information and communication services. Figure 1 shows the menu of tools available within ISJS. Moving from right to left in the figure users have access to a set of internet-based communications tools: e-mail, a browser, chat, and a news group.

The My Journal button opens a list of journal entries. There are four types of stationery for journal entries. The first is a personal entry that is used to represent an experience or reflection. The second is an append. An append is personal journal entry that is attached to another person's journal entry. For example, a mentor or other user might be reading a journal entry from a student. The reader can click the append button that allows for a new entry to be created and attaches it to the open entry. A third type of entry is a source task. Mentors create journal entries and use a toggle switch to turn the entry into a source task. Source tasks are assignments and can be distributed to students and then monitored for progress. The fourth type of entry is a task, which is what the student receives from the mentor. The sections of the task created by the mentor cannot be modified by the student. The student can, however, insert his or her response to the assignment and indicate level of progress. When entries are created or updated the author can set access privileges to be private, public or by group membership. Figure 2 shows an example list of the public documents for one user. Documents can also be arranged in folders created to represent various groupings of members for access and sharing.

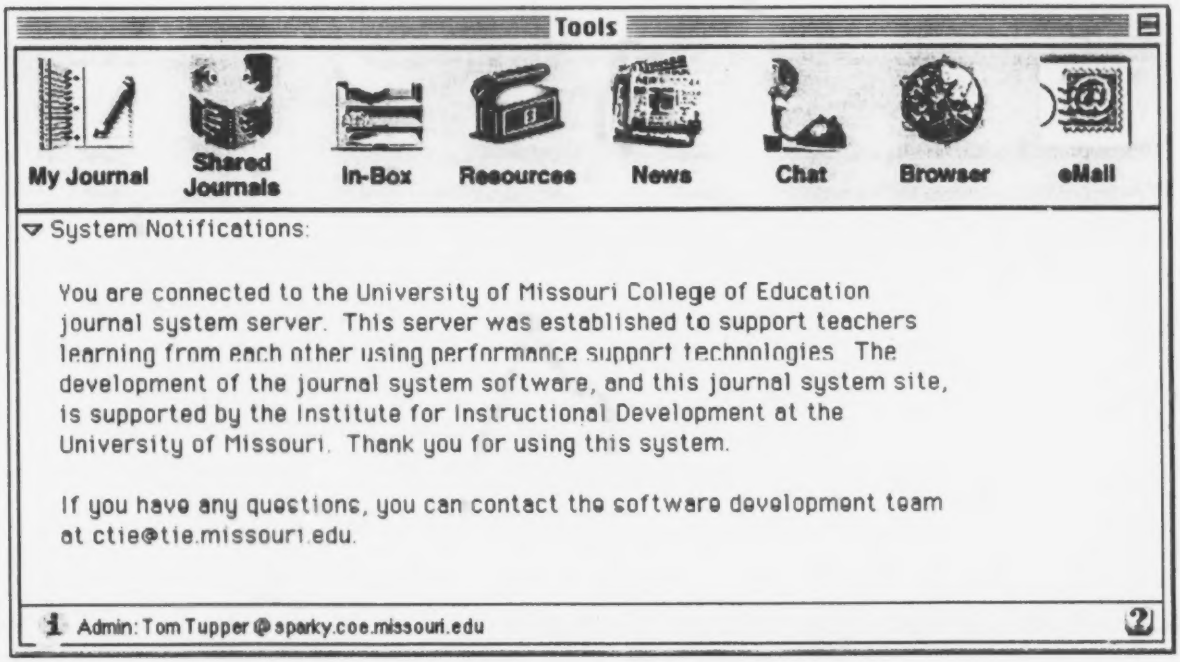
Tools
My Journal
Shared Journals
In-Box
Resources
News
Chat
Browser
eMail
System Notifications:
You are connected to the University of Missouri College of Education journal system server. This server was established to support teachers learning from each other using performance support technologies. The development of the journal system software, and this journal system site, is supported by the Institute for Instructional Development at the University of Missouri. Thank you for using this system.
If you have any questions, you can contact the software development team at ctie@tie.missouri.edu.
Admin: Tom Tupper @ sparky.coe.missouri.edu

Figure 1. Tools window provides access to shared services.

BEST COPY AVAILABLE

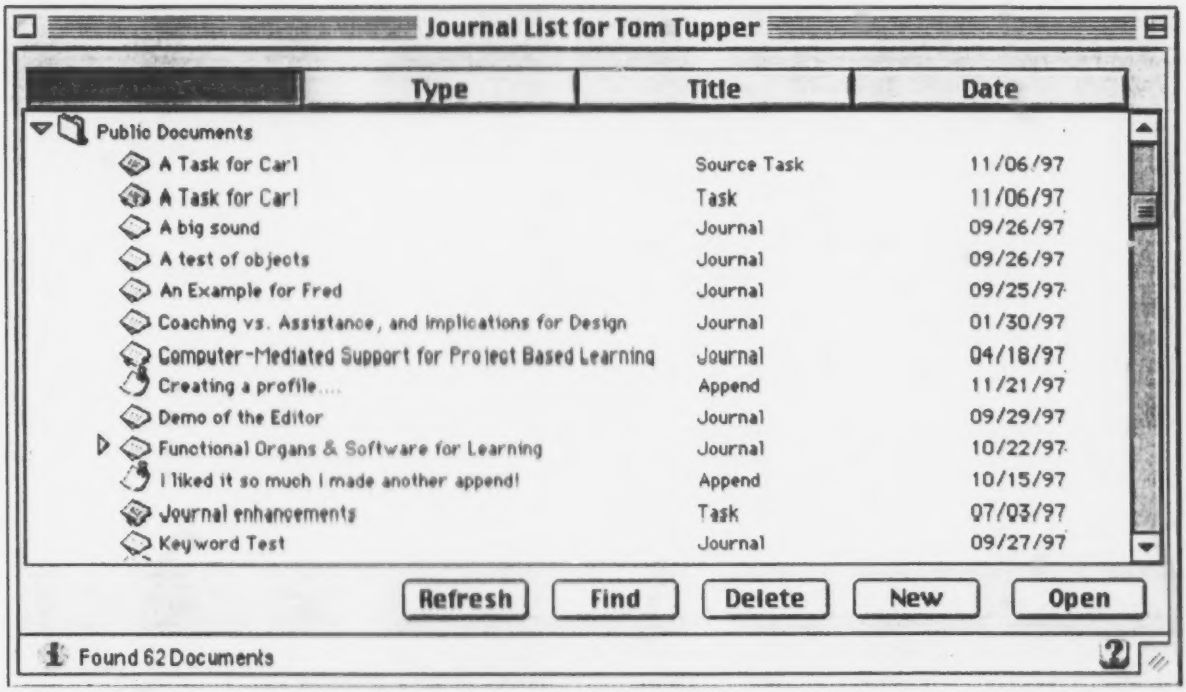

Figure 2. List of entries in My Journal

A user can create a journal entry with the New button on the list window or directly from the File menu. A standard entry has several elements: a title, keywords, access privileges, an author, a body, and it may have appends. A source task has a distribution list, and a task has a progress status. A key design goal of ISJS was to enable mentors and students to express themselves with as much representation power as possible in order to facilitate articulation and communication. To this end we have created a journal entry as a set of media and link objects. Figure 3 shows a journal entry about a discussion of software design. This one entry includes text fields, a link to a web page, a link to another journal entry, a sound object, and an image.

In addition entries can include links to other journal entries and attached binary files (e.g., an Excel spreadsheet or video clip). A key design goal of ISJS has been to make the construction of a multi-media, multi-object journal document easy and straightforward, even for a fairly novice user. The media objects can be imported into an entry through cut and paste or, if they reside as a file, in computer storage. Objects can also be acquired on the fly by selecting an open web page or journal entry, or by using a media control panel for capturing sound through a microphone, a video still from a camera, or an image from a scanner. The object rich journal entry form can facilitate the student as they capture their experience and as they represent it. For example, a student asked to visit a fourth grade class and evaluate the reading level of a child could record the child reading a passage via the microphone and then comment on their diagnosis. Fellow students or the instructor could not only discuss the thoroughness of the diagnostic report, but by listening to the audio clip could also give feedback on accuracy, as well as leave appends that extend the diagnosis.

Lessons Learned during the Pilot Year

The first cohort of students (freshmen in 1996/97) received powerbooks at the end of the Fall semester. They began to use their powerbooks and the ISJS in the Winter semester. As one might expect the first semester of implementation proved to have many technical challenges both for the program and for individual users. Much progress, however, was made and the usage of ISJS during this period demonstrated some of the potential benefits and highlighted some of the key challenges still to be overcome. Table 1 illustrates that some faculty began to appropriate ISJS into their instruction and some faculty were reluctant. Faculty High was included to represent a faculty member who made a distinct effort to implement ISJS in an extensive way. Faculty Low was included to represent a faculty member who chose not to use ISJS in any substantive way. Faculty 1, 2 & 3 represent faculty randomly selected from among the total faculty to illustrate typical use. The numbers represent journal entries from January 1997 to November 1997. The table shows the total number of journal entries

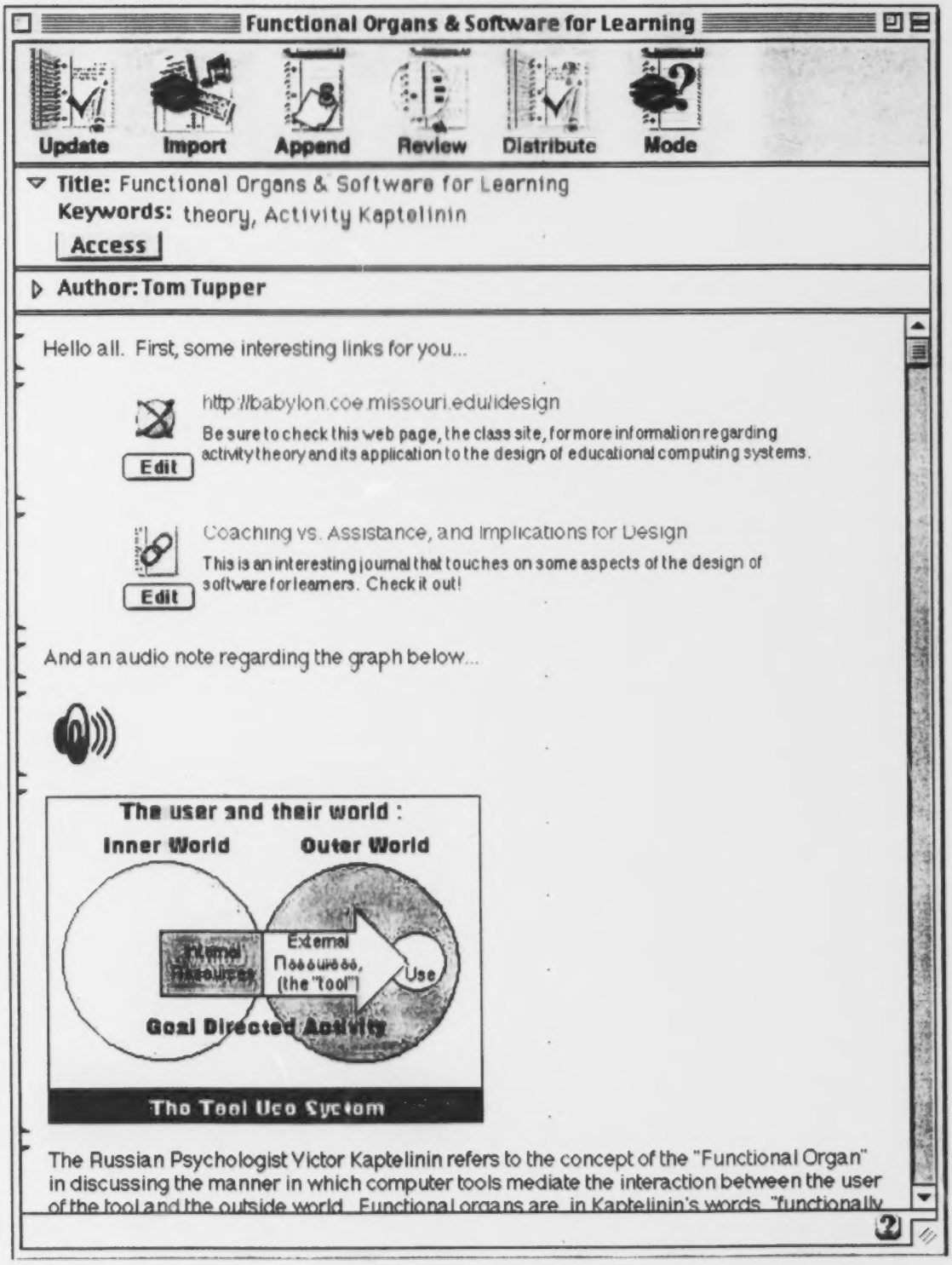
Functional Organs & Software for Learning
Update
Import
Append
Review
Distribute
Mode
Title: Functional Organs & Software for Learning
Keywords: theory, Activity Kaptelinin
Access
Author: Tom Tupper
Hello all. First, some interesting links for you...
http://babylon.coe.missouri.edu/idesign
Be sure to check this web page, the class site, for more information regarding activity theory and its application to the design of educational computing systems.
Edit
Coaching vs. Assistance, and Implications for Design
This is an interesting journal that touches on some aspects of the design of software for learners. Check it out!
Edit
And an audio note regarding the graph below...
The user and their world :
Inner World
Outer World
External
Use
Goal Directed Activity
The Tool Use System
The Russian Psychologist Victor Kaptelinin refers to the concept of the "Functional Organ" in discussing the manner in which computer tools mediate the interaction between the user of the tool and the outside world. Functional organs are, in Kaptelinin's words, "functionally

Figure 3. Journal entry showing text, sound, images and links

and the number of those entries that were appends. Student entries were taken by randomly selecting 3 students from each teachers group (total number of students in group averaged 10 to 12 members) and then averaged their counts to represent a typical student user.

Table 1.
Distribution of ISJS usage by faculty and typical student.

	Faculty Entries	Faculty Appends	Student Entries	Student Appends
Faculty High	263	254	60	28 (47%)
Faculty 1	75	70	33	10 (30%)
Faculty 2	21	6	42	20 (47%)
Faculty 3	6	1	14	2 (14%)
Faculty Low	5	1	2	>1 (28%)

Table 1 shows that use varied substantially among faculty members and their students. Faculty High used the system extensively as a means for students to capture their field experiences and create a feedback loop from faculty to student. Having 254 appends out of a total of 263 shows that most of this faculty's use of ISJS was to respond to student entries. The typical student for this faculty member created 60 entries of which 47% were appends to other students' journals. A high rate of appends indicates that the faculty had students interacting amongst themselves rather than simply creating a teacher to student channel of communication. On the other extreme is Faculty Low for whom several of the entries probably represent those made during training or practice sessions. Correspondingly his students did not use ISJS. Several faculty who chose not to use ISJS in any substantial way did have their students write about their field experiences, only they used word processors to create entries, print them out, and hand them in.

Even faculty who used ISJS extensively only used it in its most simple form. Few journal entries contain media or link objects, few faculty have used tasks to create and distribute assignments, and few faculty have used chat sessions to enhance communication among students. It is easy to project that faculty high and faculty 1 and 2 will progress toward these more advanced features of the system, but it is hard to predict whether additional support or other incentives will move faculty low and 3 toward significant use of ISJS. We do expect though, that as the total curriculum and higher numbers of faculty use ISJS in ever more advanced ways, that all faculty will adopt ISJS as a part of their teaching repertoire. In fairness to the reluctant users, ISJS and the network infrastructure needed much improvement to make them more robust and reliable. Progress has been made in these areas, but some faculty remember very well a few failed attempts. It is also true that problems still persist and will always be part of a complex intranet environment and some faculty and students are more comfortable than others with a level of risk or in their ability to troubleshoot a problem.

Some faculty have begun to develop innovative teaching approaches based on use of ISJS. Several faculty have been developing the concept of a virtual school, wherein the teacher education students create virtual students and describe their experiences and reactions to events via journal entries. A science educator has begun to use ISJS to connect his students with students in high schools who are undertaking project based learning as part of an NSF grant. The high school students use ISJS to report about their projects. The college students review the journals of the high school students and take on various roles of observer, mentor or teaching assistant and use ISJS as a vehicle for communicating with the high school teacher and students.

Questionnaires were given to students in several of the teams at midterms and at the end of the year to learn about their perceptions of ISJS use. For many students there has been quite a learning curve to use the Powerbooks, ISJS, and other technology of their freshmen year. They have suffered failures and have overcome numerous technical or user error challenges. In particular there has been a persistent problem for many students in using ISJS via a dial-up mode. This problem has significantly limited the value and flexibility of ISJS. Most students make journal entries only when required. Some students do, however, cite making entries about significant life events and discussions from class sessions. Reference to using more features and using ISJS for more varied purposes increased form the beginning to end of semester. One student stated, "Honestly, at the beginning I did my entries for the grade and for the class points. However, as time passed I wanted to share my exciting experiences with other students. I also wanted to read about the other students' observations."

Conclusions

The usage data and student reports suggest that, while there have been many barriers to usage, ISJS is supporting the reflective learning process and many faculty and students are increasing their usage and capacity with ISJS. Clearly faculty and students will need more and better support, and ISJS and the network services will need to become more robust and reliable. As faculty and students begin to appropriate and innovate with ISJS its potential for facilitating the reflective learning process will be tested and developed. Faculty and students, however, have already begun to appreciate the communication processes facilitated by ISJS, and are coming to see the value of having the "reflective conversations" of learning to become a teacher articulated and shared as a community memory.

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Virtual Tutoring Using High Speed Teleconferencing

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A recent observer of changes in our society brought on by technology (Shenk, 1997) has observed that "Information, once rare and cherished like caviar, is now plentiful and taken for granted like potatoes" (p. 32). Yet while powerful new technology now makes information within easy grasp of many, it has yet to influence in any real fashion youngsters in poor, urban areas. This project attempted to meet that need and link prospective teachers with urban youngsters using an advanced distance learning system involving high speed two-way teleconferencing designed for distance education activities.

Related Projects

Various other telementoring projects exist ranging from e-mail based question and answer systems to multi-party real-time desktop video conferencing. In the Electronic Emissary Project, for example, subject matter and pedagogical experts are matched with students and teachers who are studying similar topics (Harris, 1997). One Electronic Emissary project involved fifth grade students from Amarillo, Texas and a researcher from AT&T Bell Laboratories. During the telementoring, the researcher answered questions about sailing and celestial navigation, and suggested experiments for the students to aid in comprehension of subject matter. Similarly, in a Department of Education funded Four Directions Project, remotely situated schools serving Native American children collaborate with Native American volunteers from a wide variety of expertise and interests (Four Directions, 1997). Not only do students engage in question-answer scenarios, but they also come in contact with Native American role models. Like the Four Directions Project, the Telementoring Young Women in Science, Engineering, and Computing project encourages young women to pursue careers in science, engineering, and computing by providing support and communication from female professionals (Meade, 1997). Mentors provide advice and support on courses and careers in science and related fields, as well as opportunities for young women to discuss relationships between their classes and the experts' fields.

Unlike the e-mail dependent telementoring projects, the Global Schoolhouse Project focuses on desktop video conferencing to support its goals of teaching research skills and fostering relationships between scientists and students (Global SchoolNet Foundation, 1997). In one example of their project, scientists from the Jet Propulsion Laboratory have the opportunity to share pictures and information about on-going projects such as their Galileo spacecraft and Hubble telescope. Finally, the largest telementoring project of its kind, the Collaborative Visualization (CoVis) project, uses a wide range of collaboration and communications tools to help students in their study of atmospheric and environmental sciences (CoVis Project, 1997). The inquiry-based activities use desktop video conferencing, shared software, Internet, and visualization software to provide project-oriented activities which "resemble the authentic practice of science."

Nature of Study

The participants in this study were prospective teachers in the College of Education at Old Dominion University in Norfolk, Virginia and elementary students in an urban public school some ten miles from the university. The computer system, formally known as Interactive Remote Instructional (IRI) system, was developed as part of a grant from the National Science Foundation to Old Dominion University. IRI is a Unix-based system consisting of two classrooms of ten computers each 20 miles apart in Norfolk and Virginia Beach, Virginia and an additional mini-classroom in the elementary school. Each 'desk' consists of a Sparc 5 workstation, a microphone, speaker, video camera, and a video board. All participants, therefore, in any computer event interacted in a terrestrial-connected, 10-Mbps environment in which they could see and hear one another and dynamically share electronic resources. This project linked 20 prospective teachers with two classrooms of elementary-age children in a distance tutoring arrangement designed to test the range of instructional possibilities using a new array of distance learning tools.

Hardware and Software

The participants in this project used the distance multicast protocols and IRI software developed at Old Dominion University. All computers were connected with ATM links provided by Cox Fibernet, a cable TV service provider. A typical student desktop included a monitor

with a resolution of 1152 x 900 pixels capable of showing four windows simultaneously, which could consist of, for example, a window showing the teacher or student, a window showing a text screen with the lesson objectives, one showing a browser on the Web, and another displaying a whiteboard for mutual problem solving. The teacher's desktop was more elaborate because this machine contained the above hardware plus an overhead camera for displays and an additional video board for connecting an NTSC signal displaying a VCR or other images. The instructor's computer also contained the software (IRI Version 1.1) designed to manage communication and carry out a multidimensional instructional dialogue. In a typical full-class exchange, teachers would send students their own image and three other related images designed to enrich the experience. Whenever students asked a question, their cameras and microphones reversed the communications flow, and all participants could then see and hear them as well.

Shared Tools

Both teachers and students received the same screen images, and they also shared control over select tools. Students, for example, could send back to teachers a document or an electronic drawing they produced. Additionally, teachers and students could view the same browser session while exploring a useful Internet site, and either one could control subsequent links. Similarly, students and teachers could work collaboratively at the whiteboard passing back and forth the control and the marking function. Lesson outlines, classroom handouts, or content-related background reports could flow readily among participants; even mutually-constructed reports generated by students and teachers within the session could be saved for later use in something known as WebBooks. All electronic documents, downloaded Web material, or even teacher/student transcripts could be saved as files that became part of a student's WebBook. The WebBook collection was then made accessible to participants over the Internet from any location.

Project Activities

This project took place over one semester of 1997 and was 14 weeks in duration. To begin the project, the prospective teachers were required to participate by developing one brief (10-15 minute) presentation to be "broadcast" to groups of children in the school. The purpose of this presentation was to acclimate both the prospective teachers and the children to the capabilities of the IRI system and have them view the computer-delivery mechanism as a bona fide means of delivery of educational content. The prospective teachers were then required to work in pairs, tutoring a pair of fourth grade students in a content area the classroom teacher chose. Since the classroom teachers were involved in the planning of events, they most often asked the prospective teachers to help children find on-line resources using the shared Internet browser that was part of the system to locate information related to classroom study topics. The end goal of these activities in the teachers' views was a report developed by the children.

Participants

The participants in this project included twenty prospective teachers enrolled in a required course in instructional technology and fifty-seven students in the third and forth graders of the elementary school. The prospective teachers were required to engage the students in periodic whole-class exchanges so that all parties could become comfortable in their new electronic environment. The children involved were thirty-seven fourth and fifth grade students from an urban elementary school. The school draws from a portion of the city of Norfolk, Virginia marked by subsidized housing and high rates of unemployment. The youngsters who participated in the study were encouraged to become empowered and take advantage of the two-way capabilities of the system. The ultimate task of the prospective teachers, however, was to serve as a virtual tutor to the youngsters, helping them with their studies and exploiting the considerable power of educational technology.

Preparation of Participating Prospective Teachers

The prospective teachers who served as the tutors in this project were enrolled in a course offered by the Department of Curriculum and Instruction emphasizing educational technology. They exhibited an enormous range of backgrounds in the use of computer, including some students who described themselves as total novices and some who described themselves as highly-skilled daily users of computers. This group of future teachers were administered the Computer Attitudes Scale (1993), and the range of their composite scores, however, were very similar to those found in other research. Their mean of means score was 3.45 with a standard deviation of 1.2, again similar to other such populations.

Because the operation of the IRI system required knowledge of its interface, the prospective teachers had to be taught its use; this training required two 1-hour training session. Because they worked in pairs, they were able to help each other in becoming comfortable operating the interface.

Gathering Pre-Experimental Data

In an effort to assess the attitudes of the participants prior to the beginning of the project, both the preservice teachers and the children were asked to respond in writing to their perceptions of the idea of having a tutor appear over a computer system. Substantial details were given to what

the computers were and how the system worked. However, the explanation was purposely painted without bias and with no suggestion as to how the system should be used. Some categorized responses from the children are given below.

General acceptance

"What a cool idea."

"If I had a virtual tutor, it would be really neat."

"I would love to have a virtual tutor. Everyday I would pull out my homework, and my virtual tutor would do it for me."

Slightly qualified acceptance

"I would like maybe love to have a virtual tutor."

Specific Sub-Domain Acceptance

"It would be nice to have help when ever I want and on day I want the neadest thing I ever hade. It could help me with my spelling for exampal."

Family Benefit

"It would really help me out and it would be cool. I would really enjoy it, and my mom would too."

Perceiving the bigger picture

If I had a virtual tutor, it would be cool because, you would be alowed to say home. So you could do your work at home."

"Having that kind of technology would not only be helpful for me, but for people around the world."

Perceiving problems

"I wouldn't want to have one because I think it would be cheating. You should be listening in class so you know what to do. I think you should do your homework on your own because I think when you do it you gain knowledge and to work independently."

Advantages over traditional instruction

"When a kid logs on to a virtual tutor the kid wouldn't be afraid to ask questions that would make him or her embarrassed in class."

"A virtual tutor would not say you should always pay extra attention in class. A virtual tutor would not interrupt you while you were talking and would not say you should rewrite that."

"Maybe you could find it on the Web."

Rejection:

"I probably wouldn't ever use it because most of the time I don't need help with stuff."

Reactions from Prospective Teachers

The prospective teachers also demonstrated a considerable range of responses to the idea. Some of their reactions are given as well.

General Acceptance

"Cool idea!"

"I think it is a great idea."

"I think the idea of using a computer to teach students on the opposite side of the globe is great."

"Learning at a distance is still learning."

"I think it is great that they have computer lab time in school because kids will know how to use the computer at a young age. I know some kids that know more about computers than I do."

Special Applications

"The idea of having remote teaching is very exciting to me. Even though there are problems to be worked out such as young children knowing 'video teleconferencing etiquette.' The possibilities are incredible. Locally it would allow gifted children to challenge their intellect by hooking them up with a college student tutor who has better knowledge of a subject matter such as a foreign language."

Technological Restraints

"This is a very interesting and fascinating idea, but what are the implications in reality? There is no air conditioning in many classrooms of some public schools, not to mention electrical outlets."

Classroom Control

"I am skeptical as to how well this idea will work. First, I wonder about the discipline problems. Sometimes the student does not always want to learn and with the teacher or tutor not physically there it puts the tutor/teacher at the students' mercy. It removes the authority from the teacher and places the students and teacher on the same level. . . The cold touch of a keyboard should never replace a live human teacher."

Findings

The actual tutoring sessions were conducted with little problem in terms of hardware operation and software stability; the IRI system has been refined over the past two years. The prospective teachers did not have noticeable difficulty operating the system, but some were much more at ease in this role than others. Some remarked that the tutoring would, in fact, be easier to conduct in person in which the warmth of human exchange takes place more naturally. More information needs to be gathered regarding this issue.

It also soon became apparent that issues of management at the remote site were interfering with the tutoring sessions; fortunately, university interns were working in this school setting who could spend time supervising the participating youngsters. Final data collection is still in progress.

Need for Additional Empirical Data

This project attempted to shed light on the potential future of virtual tutoring, and it points to the need for additional empirical data to answer questions such as those that follow. Does the interactivity of the IRI system give economically deprived youngsters an added sense of self-

efficacy and self-esteem in the use of technology over time? Does IRI-based tutoring contribute to the meaningful learning of youngsters within traditional curricular areas? How realistic is electronic tutoring given the absence of human proximity and face to face contact without the availability of on-site tutors? To what extent should youngsters be allowed to control electronic dialogue? To what range of new pedagogical practices should teacher education students be exposed and what technological skills should they be required to master? What new research paradigms will best inform the profession about learning and learner/teacher relationships in an electronically rich, distance-connected environment? What does limited experience with these distance learning systems tell us about the possibility of alternative "early and continuous" field experiences? These initial attempts to make the best use of technology will help define the human and technical elements of effective technology-based learning in coming years.

Conclusion

Distance education systems such as the one described in this project are becoming more common, at least in more modest versions, and their potential to impact education is enormous. An important finding of this study is that participating children's expectations in many ways are shaped by their view of its potential, and young people are becoming more regular users of telecommunication technology with each passing day. The problems for students and teachers of the future is not whether to use computers for learning but how to navigate and assimilate growing quantities of information. A recent Time magazine (Wuff, 1997) put it this way: "All kids, not just ones from families that can afford a home computer, should grow up with a mouse in their hand. As a learning tool, computers make kids adventurers and avid learners, taking them beyond the traditional walls of the schoolhouse" (p. 31). Both future teachers and children of tomorrow may well find the prospect of a virtual tutor a comforting idea and a natural part of their learning world.

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Getting Elementary Educators Caught Up In The Web

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For the past four years I have conducted a one-week summer computer camp for fifth through seventh grade students which has been a fun and effective learning experience for the attendees. Invariably, I receive comments from elementary and middle school teachers regarding the possibility of holding a camp for teachers or allowing teachers to register for the camp. Based on comments such as these, as well as comments from my own children's elementary school teachers, I began to perceive the need to develop a hands-on learning experience for public school teachers. This learning experience would be designed to familiarize them with the resources available on the World Wide Web so that they could use the Web as a tool to enhance their teaching.

In particular, I believe teachers need to become aware of the myriad of curricular sites targeted for elementary education developed by educators for educators. They need to know about the opportunities available for collaborative learning projects and on-line classes. In addition, they need to become aware of how easy it would be for them to develop their own web lessons using web authoring tools.

I approached a fellow colleague with this idea, and, together, we developed a proposal for providing a hands-on World Wide Web training opportunity for a local elementary school. This proposal was presented to the elementary school principal in the spring of 1997, and the training was scheduled as an in-service session which would be held in late August prior to the beginning of the fall, 1997 school year.

Preparation

My colleague and I requested the name of an on-site contact person from the elementary school so that we could funnel requests for information back and forth from the school. One of our first requests of the contact was for teachers to submit a list of units they would be covering early in the fall semester of the new academic year. We requested this information last spring so that appropriate materials could be developed prior to the beginning of the upcoming school year. By focusing on topics for which the teachers were already preparing lesson plans, we hoped to demonstrate that the World Wide Web could be used as a tool to immediately enhance the curriculum which was being taught rather than an additional subject to be added to their already full load.

Our on-site contact person provided the following list of curriculum units in late May:

Fourth Grade
- Celebrations
- Nutrition
- Geography of U.S.

Fifth Grade
- Environment/Conservation
- Native Americans/N. American Prehistory
- Six Trait Writing

Sixth Grade
- Volcanoes
- South America
- Mexico

We did not receive unit information from the K-3 teachers. Our contact explained that the late elementary grades would probably have wiring to connect to the Internet in their individual classrooms by the fall semester and the school would prefer to concentrate on these grades. Based on the information obtained, we were ready to begin gathering together our web-based curriculum resources.

In preparation for this training, I subscribed to a K-12 World Wide Web Educators' listserv (WWWEDU - listproc@ready.cpb.org). This mailing list was invaluable in obtaining suggestions for web-based curriculum resources which K-12 educators had reviewed and evaluated. I saved these postings to a mail folder and in the months that followed, I visited many of the suggested sites and bookmarked those that were appropriate for K-6 educators. I made certain that at least two curriculum resources sites were identified for every unit suggested by the teachers the previous spring. In addition, since the specialty teachers and administrators were also attending this training, curricular resource sites for art, physical education, music, special education, counseling, and elementary educational administration were included. These "specialty" sites proved to be the most challenging to locate. We employed

several advanced search techniques to locate relevant, appropriate curriculum sites for these educators to visit.

Because this was to be a hands-on lab experience, we reserved a computing lab at Washburn University for this training. The university lab was chosen for the following reasons:

1. The lab contained powerful microcomputers which were connected to the Internet by means of a T1 connection. This ensured the participants would be able to browse the Web relatively quickly and not become frustrated waiting for web pages to load.
2. The university lab contained a sufficient number of microcomputers so that the participants would be able to work in pairs rather than being forced to work in groups of three or four.
3. The elementary school had been targeted to receive a new computer lab during the summer; however, there was no guarantee that the lab would be ready by the training date.
4. We were familiar with the university lab and had ready access to it while preparing for this in-service.
5. The university lab was configured similarly to the way the elementary school lab was to be configured.

After much discussion, my colleague and I decided to provide a written reference manual for the teachers to take away with them. Past experience had taught us that hands-on lab activities, while easy to complete with the instructor's guidance, become much more difficult for learners once they leave the classroom environment. By providing step-by-step written instructions for the lab activities completed during the in-service, teachers would be able to recreate this lab experience when they returned to their elementary school.

The goals of this teacher in-service training were three-fold. First, we wanted to provide background information-what the World Wide Web is, how it works, and some general searching techniques. Second, we wanted to increase the teachers' awareness of the multitude of curriculum resources already available on the Internet for K-6 educators. Third, we wanted the teachers to create a simple web-based activity using a web authoring tool. In order to accomplish these goals it was necessary to streamline the process by which the teachers would access web sites. We determined that the most efficient way to streamline web site visitation was to design a home page which contained links to various categories of web sites to visit. Because the URL address links were included in these web pages, the teachers would not be required to type in the individual locations. They would simply need to scroll down the web page, read the description of the link, then point and click to access the site. By eliminating the typing time and the data entry errors which are commonly made when entering URLs, the teachers would be able to spend more time exploring and less time typing. This proved to be a very effective method of allowing teachers to quickly "Surf the Net" and it reinforced the concept of hyperlinks.

We created the in-service home page using Netscape Navigator Gold Version 3.01. This version of Netscape contains a web authoring program-Netscape Editor. Because all of the curriculum sites to visit had been bookmarked in Netscape Navigator, it was a simple process to copy the links from the Bookmark file into the web page as it was being created in Netscape Editor. Once our home page was built, it was stored on a floppy disk along with all the associated web page files and graphics. Every teacher received a copy of this disk. During the in-service training, the teachers were able to open the home page file in the Netscape browser from their floppy disk drive and they were off and running.

Because of the limited amount of time available for the teachers to learn to develop web pages themselves, we decided to guide the teachers as a group through the creation of a web unit. I designed and created this web activity before the training was held. After reviewing the list of units submitted by the teachers, I selected the Nutrition unit to be the subject of my web-based activity. I searched for appropriate kid-oriented sites to become links in my web activity and bookmarked them. I then utilized Netscape Editor to create a web activity that would require students to read and follow directions given on the web page. Internet resources were embedded within the web activity to provide assistance to the students in completing their assignment. By utilizing only text and Internet links (no graphic images), a simple but effective project was developed which the teachers could easily complete in the limited time available to them. We incorporated a printout of the finished product into the written reference manual so that the teachers would be able to refer to the booklet as they created the web page.

As with all seminars, this seminar was planned for a particular day, with no possibility of postponement due to "technical difficulties." The major portion of this training session was dependent upon the availability of Internet resources. To prepare for the possibility of a disruption in web access, we saved all critical web sites on the floppy disks which were provided for the teachers. If the Internet connection was not available on that day, we would still be able to utilize the browser software to open these web sites locally.

Implementation

The teachers who were involved in the training varied widely in their knowledge of the World Wide Web. Some teachers knew how to access the Web and had even incorporated some web activities into their curricula. Others had limited exposure to technology and were quite apprehensive about exploring this brand new tool. No attempt was made to group the teachers by their level of expertise. On the day of the training, teachers were grouped

at the computers, two to a computer, according to grade level. In addition, the early elementary grade levels (K-1) were placed adjacent to each other as were the intermediate elementary grade levels (2-3) and the late elementary grade levels (4-6). This arrangement allowed for increased interaction among the grade level instructors who had similar curricular interests. As the day progressed, it was interesting to note how the groups of teachers began sharing information among themselves. Because of their close proximity, first grade teachers could see what the kindergarten teachers were viewing on the screen and vice versa. This led to exchanges of web site URLs and peer instruction regarding how to navigate around at different web sites.

My colleague and I designed the following schedule of activities for the in-service:

8:30-9:30 What Is This Thing Called the World Wide Web?

During this activity the teachers were introduced to the basic concepts of web pages and links as well as to how uniform resource locators (URLs) represent address locations on the World Wide Web. We discussed the purpose of the home page as well as the underlying HTML code which is used to generate web pages. We then introduced the teachers to Netscape Navigator and explained fundamental navigation activities such as clicking on links, using the navigation buttons, and setting bookmarks.

9:30-10:30 What's Out There for Educators?

At this time teachers learned how to use the home page we created which contained links to the various curriculum sites we had identified. They learned to use commands such as File | Open File in Browser and were reminded to set bookmarks at sites which they found interesting and which they might wish to revisit later. During this session, we began to see the beginnings of collaboration among the various teachers as they discovered and shared with their cohorts sites which might be useful in their own classrooms. Because we had intentionally included curriculum resources which directly related to the curriculum units they had submitted the previous spring, they were able to find relevant sites very quickly without having to learn how to ferret them out using search engines.

10:45-11:30 What Have Other K-6 Teachers and Elementary Schools Done?

We had created another linked web page which contained a list of exemplary elementary school web sites and good examples of web activities which elementary school teachers have created for their classrooms. Teachers visited these links to discover how other K-6 educators were currently using the web in their schools. Many of the elementary school links listed were using their web sites to communicate with parents and students as well as to provide web resources and technical assistance for their teachers. The web activities developed by other elementary educators gave our teachers some indication of how their counterparts were using the web as a means of enhancing learning opportunities for their students.

1:00-1:45 Internet Search Strategies

In order for teachers to utilize the web effectively in their classrooms, they needed to learn how to develop effective searching strategies so they could locate relevant and beneficial web sites to use as curricular resources to enhance students' learning experiences. We discussed the importance of determining the type of information they wanted to find (lesson plans, scavenger hunts, web activities, etc.) as well as the target audience (other teachers, students, themselves). In addition, we emphasized the need to create descriptive search strings. We then led the teachers through a series of searches where the increasingly descriptive search strings narrowed in on fewer and fewer "hits" and created a manageable number of sites to visit.

1:45-3:00 Let's Build a Web Lesson TOGETHER

The teachers were ready now to begin building their own web activity. As previously stated, I had chosen the nutrition unit to be the web lesson we would design. We walked through the entire process as a group, beginning with determining the type of information (web activity) and the audience (students). We then brainstormed a list of descriptive phrases which we could use to search for appropriate resources for their elementary students to visit as they worked through this web activity. We conducted a few of the searches, but in the interest of time, I gave them the URLs I had previously located for the web activity. The teachers accessed these locations and bookmarked each of them for use in our web activity. This gave us the opportunity to review the "anatomy of a URL" which had been discussed much earlier in the day. Once all of the sites were visited and bookmarked, we were ready to develop our web activity.

The teachers were directed to examine the printout in their reference manual which showed how our finished web activity would appear when we had completed our task. By reviewing the finished product, the teachers were able to envision how students would access our bookmarked sites as reference materials when working through this web assignment. We discussed the fact that the only difference between using a word processor and Netscape Editor to create this activity was the ability to insert links and graphics. We briefly talked about how many of the newest versions of popular word processors such as Word and WordPerfect have incorporated this web page design capability into their products.

At that point, we were ready to begin. Together we walked through the process of activating the Bookmark file (Window | Bookmarks) so that we could use it to copy our links into the web page we were creating with the Right-

click copy function. We then opened the Netscape Editor (File | New | Blank Document) and immediately named our lesson (File | Save As). The teachers were then able to type in the text of the activity as printed in the written manual. When all of the typists reached the point where they needed to insert a link, we walked through the following process together the first time:

1. Activate the Bookmark window
2. Highlight the appropriate bookmark to copy
3. Right-click the mouse and choose Copy
4. Activate the Netscape Editor window
5. Position the cursor at the point to include the link
6. Click on the Link button on the button bar.
7. Complete the link dialog box making certain that the actual URL is copied using the Right-click Paste option into the location entry box.

When the entire lesson was completed in Netscape Editor, the teachers saved the file (File | Save), closed Netscape Editor (File | Close), and accessed their newly created web activity (File | Open File in Browser) to check their work.

3:15-4:00 How Could You Use the World Wide Web In Your Classroom?

The final activity of the day required the teachers to work together by grade level to synthesize what they had learned during this in-service and to brainstorm ideas as to how they might be able to utilize the World Wide Web to enhance their students' classroom learning experience. Several of the suggestions shared by the teachers appear below.

1. Students could access several of the excellent Civil War sites on the Web to locate information for research projects they complete during the school year.
2. Teachers could search for existing lesson plans at the curriculum resource sites they had visited.
3. Students could access Native American Indian tribal sites to learn about the history and culture of various Indian tribes they would be studying.
4. Teachers could download activities such as coloring pages and crossword puzzles already available on the Web to use in their classrooms.
5. Students in the early elementary grades could use interactive Web sites dealing with colors and shapes to assist them in learning these concepts.
6. Teachers could find information on the Web regarding Johnny Appleseed which they could incorporate into their lesson on this historical figure.
7. Teachers could use the "Problem of the Day" site to introduce mathematics concepts each day.
8. Teachers who would be teaching the nutrition unit had already decided to use the Nutrition Web Activity developed during the in-service. They also indicated they wanted to add some graphics to the page to enhance it visually.

Feedback from the Teachers

The response from the teachers was very positive. I have included a few of their comments:

> "You made the class fun and interesting, and you were so kind and helpful."
>
> "Thank you for a very valuable, informative workshop!"
>
> "You taught us useful skills on the Internet."
>
> "You made the class very relaxing and enjoyable!"
>
> "Had you read our outcomes? The curriculum resources we visited fit so nicely with our grade level outcomes."
>
> "I have been to meetings before where you are shown how to develop web activities; but actually doing it myself, I understand what is going on."

Those teachers who had previously been exposed to the Internet commented that they had learned more than they expected. The teachers who had very limited exposure were astonished at the resources that were available on the World Wide Web. Most, if not all, of the educators left the session eager to explore in more detail the curricular web sites they had visited or wanted to visit and to incorporate this technology into their curriculum.

Critical Success Factors

The success of this in-service seminar was based on the following critical factors:

1. The establishment of an on-site contact person increased communication between the school and the presenters so more relevant training content could be included in the training session.
2. The grouping of teachers by grade and placing them adjacent to teachers of similar grade levels (K-1, 2-3, 4-6) led to sharing of web resource information since the groups had similar curricular interests.
3. The use of HTML pages as the major technique for facilitating technology transfer was central to the success of this training.
4. The creation of lab activities which were challenging in concept yet were relatively simple to implement sustained the interest of all participants.
5. The availability of an appropriate lab facility was essential. Powerful microcomputers, high-speed access, and a sufficient number of computers to allow a hands-on experience created an effective learning environment.

By designing an innovative training session which consisted of easy-to-accomplish, hands-on tasks which were relevant to classroom teachers my colleague and I were successful in getting elementary educators caught up in the web.

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I would like to thank my colleague in this endeavor, my husband and fellow web educator, Michael Tate.

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A Study of the Internet Research Activities of Preservice Teachers

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The Internet provides students with information which is dynamic, interactive, and diverse in nature. With the enormous growth of the Internet, more teachers are encouraging students to use the Internet as a resource for classroom activities. The notion of Internet as a research tool for students is beginning to emerge. In an email survey, Starr & Milhei (1996) found that professors were just beginning to use the Internet for student research. As with the introduction of any new technology, the use of the Internet as a research tool may pose more questions than answers. This paper will address several questions related to the resources given to students to conduct Internet research and identify areas for future research.

Role of the Teacher

The role of the teacher in providing Internet assignments can range from information provider to problem presenter. The goal of the teacher should be to create an environment in which students think, explore, and construct meaning (Nicaise & Barnes, 1996). Students should spend less time looking for information and more time synthesizing, analyzing, and reflecting. Students should develop "digital literacy" (Pool, 1997), the ability to understand, evaluate, and integrate information in multiple formats.

Meaningful Internet research should take advantage of the interactive and dynamic nature of the Internet. Students should be able to utilize information which is not easily attainable from other sources.

Teachers who give assignments in which students are required to gather information from the Internet are faced with many questions:

1) Should students be directed to specific web sites for research or should they be given the freedom to explore their own sources of information?
2) Can students identify valid sources of information (Duncan, 1996) and separate "junk" information (Nigohosian, 1996) from reliable sources?
3) Will students conduct more research if they are given web sites or if they are allowed to explore on their own?
4) Does the level of research affect students' willingness to conduct research?

Internet in the Teacher Education Program

Fueyo & Koorland (1997) propose the idea of enhancing teacher professionalism by the integration of research in the teacher preparation program. One way of accomplishing this is through the implementation of Internet research in courses throughout the teacher education curriculum.

Although more students are using the Internet on their own, assignments which require students to conduct basic Internet research may stimulate them to use Internet as a resource in future classes. Farenga & Joyce (1996) describe a model in which short-term Internet training was sufficient to change education students' behavior regarding use of the Internet.

Levels of Internet Research

Barron & Ivers (1996) identify three levels of Internet research: basic, advanced, and original. Basic Internet research refers to retrieving information from a single resource. Advanced Internet research involves high-order thinking skills and requires the student to analyze and synthesize information. Original Internet research is investigative in nature whereby students may conduct survey and experimental research. This study addresses the first two levels of Internet research: basic and advanced.

Purpose of the Study

The purpose of this study was to determine the relationship between levels of Internet research and number of Internet resources given to students and their effect on the number of web site resources used by students during Internet research.

The following questions were asked:

1. Should students be given web site resources to conduct Internet research?
2. Is there a relationship between the number of web sites given to students and the number of web sites used by students during Internet research?
3. Will students use more web site resources in conducting basic Internet research or advanced Internet research?

Procedures

Subjects were approximately 250 students enrolled in an introductory course titled "Field Studies One." This is a one-credit course required for elementary and secondary education majors and is usually the first education course taken in their program. As a part of course requirements, students were given two questions which required them to conduct Internet research. Question one was at the basic research level in which students were required to retrieve 5 sources of information from the Internet. Question two was at the advanced research level in which students were required to retrieve and synthesize Internet information in response to an analytical question. For each question, students were required to support their answer with a bibliography of web sites. Students were not required to utilize a minimum or maximum number of web sites in formulating their answers.

The subjects were randomly assigned to one of three groups according to the web sites resources given to them:

1) Group One was not given any web sites to use as a resource.
2) Group Two was given one web site for each question to use as a resource.
3) Group Three was given five web sites for each question to use as a resource.

Each web site given to groups two and three provided sufficient information to answer the question without further exploration. The content of questions was different for each of the three groups to prevent students from sharing the given web site resources between groups. However, the research level of each question (basic for question one and advanced for question two) was consistent from group to group.

Research Design

This study employed a 3 x 2 factorial design (Borg & Gall, 1989). The independent variables were (1) degree of information given to students (no web sites, one web site, five web sites) and (2) level of research (basic and advanced).

The three types of information given to students were crossed with the two levels of research. The dependent variable was the number of web sites students reported for each question (question one & question two).

A two-factor analysis of variance (ANOVA) will be conducted to determine whether the mean differences between the number of resources are statistically significant.

Conclusions

Results will be reported in the final presentation of the paper.

Conclusions will address the following questions:

- What is the relationship between the number of web sites given to students and the number of web sites used by students during Internet research?
- What is the relationship between the levels of Internet research (basic and advanced) and the number of web sites used by students during Internet research?
- What are the implications for teachers who give students web site resources to conduct Internet research?

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Guiding Students in Web-Based Research Projects

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Students (and their instructors as well) are often surprised and disappointed to discover that using the World Wide Web for research assignments does not automatically enable them to do faster research or write better papers. In fact many high school, undergraduate and graduate students are overwhelmed by a research assignment involving the web. When they cannot manage the volume of information, instructors see a variety of problems, from poorly-focused topics and reports that lack coherence and organization, to assignments with inappropriate referencing or even plagiarized materials.

Numerous publications that guide students in doing research on the web (e.g., Branscomb, 1997; Calishain, 1996; Campbell, 1995; Harris, 1996; Maloy, 1996) try to address these problems. Some guides are available on-line (e.g., Cummings, 1997; Rodrigues, 1997; University of Tulsa, 1997). However, the wide variety of research assignments in the various academic disciplines makes it difficult to provide universal guidelines for students. The instructor is in a more strategic position to address the problems. The instructors' structuring of assignments will most likely enable students to conduct their web-based research more efficiently, and to produce work that is more focused and pertinent, more up-to-date, and less likely to have been plagiarized. Strategies for doing this are described in this paper.

Research papers, projects and assignments refer to any class assignments that involve library materials that can now be accessed via the Internet and the web. They include reviews, position papers, theses, assessments or other studies (interviews, questionnaires, surveys, case studies), annotated bibliographies, and other papers, reports or assignments that involve traditional or electronic library material. Assignments like these are made in classes in the arts and humanities, in the social sciences, in the natural and applied sciences, in business and management, and in professional development courses in many fields. Instructors at all levels from the elementary grades to graduate and professional schools make these assignments.

Infrastructure

Web-based assignments require institutional infrastructure that includes considerations of equipment and software, as well as library support facilities and staff to assist instructors and students. School networks linked to the web and other community or home access to the Internet are necessary. Access to appropriate research and academic databases, available by institutional or individual subscriptions, must be in place. Software tools including web browsers, word processors, image editing software, and presentation or multimedia authoring software are necessary for students to conduct their research on the web, to organize their material, and to submit, present or publish their reports. Assignments involving collaboration also require e-mail or conferencing capabilities.

Students and instructors must have the knowledge and ability to use these tools to work productively on their papers, projects and assignments. The training or orientation to these tools may be provided in several ways such as workshops or mini-courses; personal assistance in libraries or in labs; telephone or e-mail consultation or help-line; on-line tutorials and references. Schools must commit to and provide adequate staffing, facilities and other material support for the workshops, for the library and lab assistance, for the help desks or for the on-line programming and design.

Instructors may either expect students to know how to use the software tools as a prerequisite to the class or activity, or they may ask students who do not have prior experience to learn the skills concurrently with completing the assignment. Instructors themselves should be familiar with the tools, preferably, before making the assignments. However it is possible for instructors (with some risk tolerance and flexibility) to be learning to use the tools along with students doing the assignment.

Reliability of the technologies is an important consideration for the institution, the instructor and the student. It is the school's responsibility to provide consistent access on the school's network, and to ensure that their ISPs and database vendors are also reliable in their service. Instructors may provide students with contingencies, precautions and alternatives in dealing with technology reliability issues. For example, instructors may place class web pages on multiple (mirror) servers, or provide links to different servers that provide access to particular data bases. Students need to be aware of these reliability issues and be flexible.

They should be aware, for example, that the instructor may not accept their excuse that the DNS was down 24 hours before the project was due when they just started to work on the assignment.

Strategies and Resources

Strategies for guiding students in doing research on the web are grouped into six areas: (1) selecting and focusing the topic, (2) organization and timeline aids, (3) strategies for searching the web, (4) strategies for collecting and organizing the materials, (5) minimizing plagiarism, and (6) options for publishing students' work.

1. Selecting and Focusing the Topic

The selection and focus of the topic may be the most critical factor leading to the success of a research paper or project. The definition of the research topic, the degree of specificity and scope of the topic can determine the quality and quantity of the sources to be found. The instructor's assignment objective defines how the topics will be selected, and how narrow or broad the topic will be. Given that, instructors should strive for the most specific research topic as is reasonable. The volume of material available on the web makes it possible to find answers to very specific questions. In an American History class, for example, a topic such as the Truman Presidency should be narrowed, first to a situation like the 1948 election, then to specific issues and questions such as: "What were the polling strategies the media used in the 1948 Presidential election?" "Compare the campaign strategies Truman and Dewey used in the 1948," "What were the expenses and sources of funding for the 1948 Presidential campaign?," "What media did Dewey and Truman use in the 1948 campaign?" or "What were the most influential themes in Dewey's and Truman's campaign speeches in the 1948 Election?"

Whether students choose their own research topics or are assigned the topics, the topics should be narrowly focused. It may be helpful to require that the topics be declared in the form of a question. If the assignment is a term project, have the students submit their research questions early in the term. This enables the instructor to provide students with feedback and suggestions on the workability of topic. The feedback and suggestions returned may be alternative phrasing of the topic question, suggestions for different perspectives in the study (e.g. seeking the pros and cons of a controversial topic), and suggestions and alternative questions for further narrowing the focus of the topic.

Instructor feedback can be supplemented with student-to-student collaboration in defining the topic. One format is to place students in groups of 3-4. In these groups, the student tells the others his or her proposed topic and what feedback the instructor gave. The group members provide additional suggestions on the selection and phrasing of the research question. Each student then decides on revisions and resubmits the proposed research topic to the instructor.

The topic selection process can be further facilitated by the instructor providing a worksheet or form in which the requirements and steps are listed, and space is provided for including topic proposed, instructor feedback, peer suggestions, and revised topic.

2. Organization and Timeline aids

When the instructor provides organizational structure for the assignment, students are more likely to fully understand the assignment objectives and are more likely to achieve the objectives. Organizational structure refers to (a) the elements required in the research report or assignment, and (b) the process for doing the assignment.

Instructors should strive to be as clear as possible about what they are seeking in the research report. This should be made explicit to students. For example, an instructor might convey to students that the project should contain the following elements: A personal and academic rationale why the topic is a compelling one; historical background on how the topic has been addressed past and present; the kind of charts, maps, photos, tables, or other graphics that would be relevant for the report; a personal synthesis; and recommendations. Instructors may also prescribe that students follow a particular outline for the reports. Students find that it is helpful when instructors provide guidelines for the maximum, minimum or expected lengths for each section. The length of each section may be given as the number of words or page length for written reports, or the number of screens for each section in a presentation.

Students are aided when the instructor understands the process by which the assignment is done and communicates this to students. This process may be linear-sequential, or looping, or a combination of both. For example, a linear-sequential process may be: (1) brainstorm possible topics, (2) select the most interesting and workable, (3) focus the topic and define the question, (4) conduct the literature search, (5) retrieve the documents, (6) select relevant data, (7) assemble material into the outline, (8) write the report, (9) revise and edit the report, and (10) submit the report. A looping process might involve repeated searches, weekly revisions of the research topics, and an evolving annotated bibliography.

In either process, the instructor should consider requiring students to submit their work in progress throughout the period. Check points and due dates for various steps in the process ensure that students are proceeding appropriately, and the instructor can correct problems before the student submits the final report. For example, due dates can be set for the intended research topic, for a printout of the search parameters, and for working reference lists.

3. Strategies for Searching the Web

Instructors can refer students to the numerous guides which provide instructions on how to do research on the web. (See References below.) These guides provide helpful strategies and resources for conducting searches. In addition to these guides, instructors should provide instructions, guidelines and resources which are particular to the discipline or topic, to the particular relevant data bases, and to the objectives of the assignment.

Instructors should define which databases are appropriate for the assignment. For example, an instructor for a course on child psychology might require that students only use PsycFirst (1997) or Ovid Mental Health Collection (1997) for their searches. There are several advantages to restricting students to using only discipline-based databases: Students are less likely to be overwhelmed or distracted by the volume of resources. Students become more familiar with the literature of the particular academic discipline. They get to relevant and appropriate material more quickly. They can be more certain about the credibility of the sources.

If instructors provide web pages or resource lists for their courses, direct links to the prescribed databases may be included. These links enable students to select and access the appropriate data bases with less chance of misdirection or errors typing URLs.

In addition to directing students to discipline-based databases, it is important to provide guidelines on entering search parameters in those databases. This information may be available on-line in the particular database, or it may be one of the services provided by the school's library or computer resource center, or it may be explained in publications on Internet research. The instructor should point students to the resource that will provide the necessary guidelines for entering search parameters. If such a resource is not available, the instructor should prepare a brief list of suggestions and instructions that will assist students in making their search efficient. For example, instructions for searching the journals in education in a "Contemporary Educational Issues" course were given as follows:

1. Access the ERIC databases through FirstSearch Databases on the Eden-Webster Library web site (http://library.websteruniv.edu/database.html#e). Enter your student ID number when prompted.
2. On the Search Screen, click on the button labeled "Advanced Search."
3. Enter your topics in the "Search For" field. In the "Search Type" field, click in the box marked "Subject." Limit your search to recent years, such as 1992-1997. In the "Division" field, select the CIJE (Current Index to Journals in Education). In the "Language" field, select English. Click on the "Start Search" button.
4. From the list of articles, click on the underlined title to view the full abstract and bibliographical information for each article. You can Print or Save (to a disk) this information by choosing these commands from your computer's file menu.
5. On the Results screen, you may also click on the checkbox marked "Tag Record" for each article you want to save or print. When you have marked all the articles you want, click on the button marked "Show All Tags." You can then print, save or e-mail (to yourself) the entire list of articles with abstracts.

Research assignments may also involve library catalogs, databases to popular periodicals, newspapers, other news media (e.g. television, syndicated wire services), maps or graphics. Some assignments may also involve searching the web or newsgroups using web search engines. If so, instructors should customize instructions for these sources as appropriate for the assignment.

4. Strategies for Collecting and Organizing the Materials

Instructors can provide specific suggestions to students to make collecting and organizing material from web sources efficient. A worksheet of instructions or an in-class demonstration may be sufficient. For example, the following instructions provide such guidance:

1) Open both the word processor and the web browser.
2) Highlight the text you want, and use the copy function in web browser.
3) Paste this text into the word processor document.
4) Copy the URL from the browser's location window and paste it into word processor document.
5) After the search, edit and reformat the report.

To further assist the student in the organization, instructors can provide students with a template of the prescribed outline. Students paste the material they are collecting from the web search into appropriate sections of this template, thus saving them time deciding where the material will go.

If the final form of the research assignment is a presentation or hypermedia stack, then the presentation software or the cards of a hypermedia stack could replace the word processor in the instructions to students. The instructor may also provide students with a template for the presentation or the hypermedia stack.

5. Minimizing Plagiarism

Instructors are understandably concerned about research on the web increasing the opportunity for plagiarism. While there may not be any surefire means to prevent or detect plagiarized work, instructors can take steps to minimize its occurring for their assignment. The following suggestions may be appropriate for a variety of web-based research assignments:

- Require citation of all sources. Have students include all URLs, and announce that instructors will verify these URLs.
- Require fresh sources. In many research projects, instructors could require materials to be those that were posted in the current semester or term, or in the last several months. This ensures that another student's report from a previous semester is not likely to be submitted without additional current research.
- Require analytical links between textbook and current resources from the web based materials. For example, ask students to relate how a current event found in a web search relates to a case described in the textbook .
- Require personal links. Ask students to include personal experiences that can be related to the research. This may be included in giving a personal rationale for the topic, in providing a personal experience anecdote, and in synthesizing the material or in making recommendations for oneself about actions steps involving the topic.

6. Options for Publishing Students' Work.

The emerging technologies enable students to submit, present and publish their work in new ways. In addition to research reports submitted on the traditional term paper formats, other electronic formats may be used. The same report may be submitted on a floppy disk, or via e-mail. The report can be distributed easily to other students or instructors. The report may be done on media other than a word processor, such as on presentation software, on a hypermedia stack, or on a web page authoring tool. These formats make it possible for the student to present the research report to the class or other group, or post the report on the web, on a CD-ROM or even record it on a videotape for playback on a VCR.

These new opportunities for students to show their project to others besides their instructors, increases the potential meaningfulness of the paper or project. Instructors should use these avenues for students to share their research results with others as a way to increase the value and meaning of each student's work.

Discussion

If an instructor has not previously used the guidelines and suggestions outlined in this paper, it may be unrealistic to expect one to be able to implement them all right away. Each guideline and suggestion has underlying pedagogical assumptions that instructors may or may not agree with. Instructors must think through the implications of the change on their own pedagogy or teaching style. It takes time and several rounds of revision to get things to work for each assignment. In fact, instructors who have used written research guidelines for their assignments continue to frequently revise both the assignments and the written guide sheets. Nevertheless instructors who wish to assist their students in improving their web-based research are likely to find the suggested direction invaluable for their students.

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Through The Eyes of Students: WWW Navigation Nightmares

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Frustration, Frustration, FRUSTRATION . . . . . Students are not unlike their teachers when confronted with the use of technological innovations such as the World Wide Web. For many, this new instructional tool produces an inability to cope with the confusion presented by inappropriate web site design. Novice web site authors, who may have very little knowledge in the area of instructional design, are exacerbating the frustration. In most cases, without even knowing. . . . . they have created a NIGHTMARE for the innocent student. Have some forgotten that providing students with a positive, experience based instructional design ought to be the essential foundation for all learning experiences? There should not be significant differences in the development of sound instruction, just because the instructor is trying to integrate the use of technology into the learning processes.

The emergence and use of web sites for the immediate access and dissemination of information provided by instructors has become a phenomenon for the 21st century high school and college classroom. One of the most obvious observations of this rush to the web is the naive use of hypertext linking (Schoon, 1997, p. 4). According to Sano (1996) "Unfortunately, many web sites today appear as if they were hurried onto the net, disregarding user's needs, requirements, and preferences" (p. 13). How many web site authors know what hypertext linking is or what linkage models are, as well as their appropriateness for use with specific instructional applications? Increasing numbers of educators are examining how the World Wide Web can help in the classroom (Dyrli & Kinnaman, 1995), but are the results of those studies reaching instructors who are taking on the responsibilities for the authoring of web sites?

Two years ago, Doty (1995) stated that lesson plans, projects, and resource kits are being developed and (Ryan, 1995; Sanchez, 1995) affirmed that interesting sites for student access are being identified. With all of the development and identification that has been undertaken in the past several years, one would think the frustrations of students must be non-existent in our classrooms and computer labs. Unfortunately, that may not be the case in most institutions. As the nation's schools move toward adopting a more technological approach, the future of instruction may be based on how quickly the schools can be wired for those multiple trips down the information super highways to the interactive world of the Web Site of Knowledge. Where are the checks and balances? Who is evaluating the competence of the designer when using this new instructional tool? Could it be that some instructors are blindly creating web sites with those "navigational nightmares" their students have been identifying in recent studies?

This paper will address several issues that students have identified in two independent studies conducted at a midwestern university when using the world wide web in instruction. The high incidence of frustration reported by these students may provide insights into the necessity for proper instructional design and modeling. Findings of both studies indicate the need for greater commitment from educators in utilizing appropriate design principles for both informational and instructional web sites.

The Studies

A total of 314 students participated in these studies. The majority of the students were juniors having various content specializations. The participants were represented by 171 males and 143 females. The sample from the Weber (1996) study was comprised of two sections of teacher education students. The Schoon (1997) study consisted of students in two sections taking courses in the business department. The studies used various quantitative and qualitative research methods to analyze the data.

Each of the studies had been designed to help researchers understand what barriers students encounter as they are introduced to Netscape navigation and the use of the World Wide Web from an instructional perspective. Duchastel (1990) suggested that hypertext usage could be categorized into three broad forms: cultural, educational, and informational. "These forms constitute a continuum on which the

elements vary in the degree of explicit goal directiveness" (p. 224). Users at the information end of the continuum are looking for information that they need to answer a question they have. This type of discrete information is called closed-task information. A closed-task is one in which there is only a single factual answer to a question (Marchionini, 1989). Although the two studies identified were being used in an instructional setting, the web site assignments were designed using the hypertext category which by definition was informational not educational.

Data Collection

The 1996 study used five questionnaires to collect data. One instrument Mid-Term Course Analysis (MTCA) collected data mid-term and one Barriers Identification Survey (BIS) was administered end-term to provide a comparative evaluation. The 1997 study used one questionnaire and one participant activity sheet that was completed after the student concluded the WWW navigational activity with a randomly assigned hypertext linkage pattern e.g.: (a) linear (with side steps); (b) star (extended); (c) hierarchy; and (d) arbitrary.

Findings

Content analysis of the MTCA and BIS open-ended questions from the 1996 study provided 13 categories of barriers which were identified by participants and determined as either internal or external. The following statements are representative of the comments made by students who completed a WWW search activity:

Internal Netscape Barriers

- I got very frustrated because I felt like I was wasting my time spending hours finding answers
- I was frustrated with the way Netscape was presented to us
- We weren't given enough background
- Time was a factor when using Netscape. . . In order to find one piece of important into, it took a couple of hours. . . This was not possible for me. . . Netscape was not useful
- Becoming overwhelmed with the amount of info available!
- This program is so confusing! . . I never knew how to go from here to anywhere!;"
- I was frustrated because it is so hard to relate the information I found to actually doing something. . It's very subjective. . . The information can guide students, but the Internet cannot teach
- Sure, 'surfing' is easy, but searching is a different story. . . I also needed long blocks of time to get something substantial, like 3+ hours, but I never spent that long at a terminal
- It is intimidating. . . I feel like they said, (they being the instructors on using this equipment) 'Hey kid, here's how you click a mouse. Now go find the most obscure info in the world!
- It has been difficult motivating myself to want to use this system. . . I believe that information found on the Internet is available in books, as well, and as a result, most research I have done has not included the Internet (Netscape), because the 'old-fashioned' way is much more comfortable to me.

External Netscape Barriers

- The most frustrating part of using the Net was the 'Professional Inquiry' project!! . . We had very little knowledge or experience using it and because of that fact it took me 2 days (eight hours) of time-consuming frustration trying to find the answers! . . What was the point of the project? . . We could have learned faster methods of exploring the Net by working in groups within class!
- The in class sessions were terrible. . . The lab instructor didn't know how to teach and in fact, didn't teach us anything. . . I learned how to do this myself.
- Although there were many similarities as well as apparent differences identified by the students, there was a statistically significant difference reported between male and female students and the use of Netscape. Female students reported having more difficulty than male students.

Findings from the 1997 study were based primarily on the data collected from the WWW search activity where the participants were randomly assigned to navigate one of the four web sites designed using one of the four hypertext linkage patterns. Of the 261 participants, 66 were assigned to the linear site (25.3%), 65 to the star site (24.9%), 66 to the hierarchy site (25.3%), and 64 to the arbitrary site (24.5%). Over 77% of the students in the study rated themselves as being somewhat inexperienced or less. Only one female rated herself as being very experienced with using the web over the past two semesters.

In order to help distinguish the barriers students encountered during the web site navigation, a final path steps was computed for each incidence. The final path steps are the number of steps taken by a web user from the home page directly to the location of the desired information (target page). The final path step numbers for three of the four web sites constructed for use in this study were equivalent to the number of steps in the optimal path. This is due to the fact that for the linear, star, and hierarchy web sites, there was only one possible path for a user to navigate to find the desired information. The hierarchy site has three steps in the optimal path. The star site had four steps in the optimal path. The linear site had eight steps in the optimal path. Only the arbitrary site offered web users more than one path to the desired information (target page). The minimal number of steps for any of the optimal paths for this site was six.

Because there was only one possible path for a user to navigate to the target page in the linear, star, and hierarchy web sites, the overall mean number of final steps for both genders for these sites was equivalent to the optimal number of steps for these sites (see Table 2). Only the arbitrary web site varied in the number of final steps. The overall mean number of steps for the arbitrary site was 6.80 (SD = .80). It took females fewer steps than males to arrive at the target page on the arbitrary site. The 29 females assigned to the arbitrary site had a mean number of final steps of 6.76 (SD = .79) while the 35 males assigned to the site had a mean of 6.83 (SD = .82). However, females had on average more restarts and revisits than males did.

Restarts were also computed for analysis. A restart occurs when a user goes back to the homepage either through revisits (backing up) or by pressing the home key in the World Wide Web browser. The home key in the browser used for this study was turned off. Therefore, in this study, a restart could only occur through revisits. Overall, the most restarts occurred within the arbitrary web site. The least number of restarts occurred in the hierarchy web site. Both male and female participants assigned to the linear and hierarchy web sites averaged less than one restart. Both male and female participants assigned to the star and arbitrary web sites averaged close to one restart. Females assigned to the arbitrary web site averaged close to two restarts. On average, females had more restarts than males in all of the four web sites in this study.

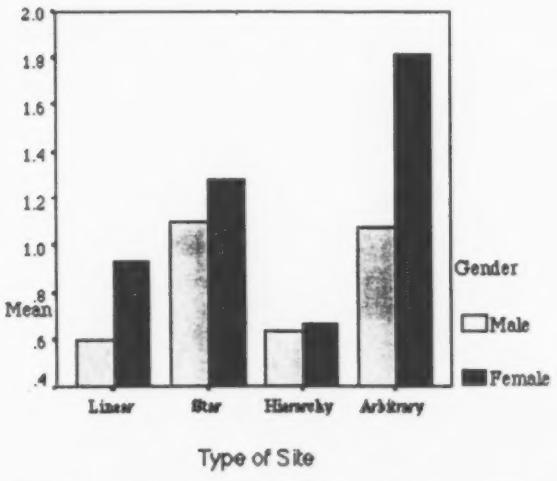

Figure 1. Restarts by Gender and by Type of Site.

Revisits were also determined as important to the collection of the data. A revisit occurs when a user goes to an HTML document that he or she has already visited. Whether the participant uses the forward or backward button to revisit an HTML document is not important, only that they have revisited a document. Overall, the most revisits occurred within the arbitrary web site (M = 24.20). The least number of revisits occurred in the hierarchy web site (M = 1.67). Males had, on average, more revisits in the hierarchy web site. Females had, on average, more revisits than males in three of the four web sites in this study. Overall, the most revisits occurred within the arbitrary web site (M = 24.20). The least number of revisits occurred in the hierarchy web site (M = 1.67). Males had, on average, more revisits in the hierarchy web site. Females had, on average, more revisits than males in three of the four web sites in this study.

Figure 2. Revisits by Gender and by Type of Site.

Analysis of the data showed that:

- linear, star, and hierarchy hypertext linking patterns are all more efficient for finding closed-task information than an arbitrary hypertext linking pattern. The star and hierarchy hypertext linking patterns are also more efficient than the linear hypertext linking pattern,
- there were no significant differences between experienced and inexperienced World Wide Web users in their efficiency in finding closed-task information within web sites constructed using different hypertext linking patterns, and
- there is a significant difference between males and females in their efficiency in finding closed-task information within the arbitrary web site. Males, as evidenced by a lower NAE value, had an easier time of navigating this type of web site than did females. There is no significant difference between males and females in their efficiency in finding closed-task information within the linear, star, or hierarchy web sites.

Conclusions

These studies were conducted to provide a foundational investigation of use of the world wide web in an instruc-

tional setting. The samples in these studies, although limited in number, recognized the barriers that inhibit to some degree the students' efficiency relative to the learning processes. Students told the researchers of their frustrations repeatedly. If frustration would have been identified by the number of revisits and restarts the students encountered, then the data collection findings may indicate why there ought to be concern for the appropriate designing of web sites for instructional purposes. As the community of educators moves into the technological classroom, instructional designing for the improvement or enhancement of the learning processes must be strongly considered as top priority, rather than rushing to the Internet to produce Frustration, Frustration, FRUSTRATION.

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Developing and Delivering Instructional Technology for In-Service Teachers

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Although its official title is Development and Delivery Utilizing Technology, the students and I wound up referring to the course as "geek boot-camp." (The term "geek" is one that I and other students in Indiana University's Department of Instructional Systems Technology use with great pride; it signifies to us a level of technological mastery and computing skill.) The residency portion of the course was indeed a "boot-camp" setting: up early each day, learning new skills, and putting those skills to use negotiating a series of obstacles. There was laughter, there were tears...there was stress. The results however seem worth the effort.

Course Description

The course Development and Delivery Utilizing Technology is part of Walden University's new Educational Change and Technology Innovation (ECTI) master of science program. Walden's ECTI program is intended for in-service professionals, the majority of whom work within a k-12 environment. Development and Delivery Utilizing Technology was offered for the first time this past year in the summer of 1997. The students consisted of seventeen individuals from various parts of the United States; they included nine classroom teachers, two library and media-resource specialists, and two district technology coordinators working in k-12 public and private school settings. Of the three students not placed in k-12 settings, two worked in post-secondary settings; and one worked as a corporate trainer. All students had at least three years of professional, in-service experience (the majority had ten or more years of experience). The range of students' technological expertise and comfort level was extreme: some were experienced multi-media producers; some were technology "newbies" with little more than basic competence in using e-mail software. All were bright, highly motivated individuals capable of the independent study required by Walden's distance-education format.

The course includes an introduction to instructional design theories, principles, and processes as well as the opportunity to work with advanced, computer-based technologies including HTML, multimedia-authoring tools, and desktop-publishing software. During the course, students were assisted in the development of personal guidelines intended to assist the decision-making processes that accompany the production, utilization, and evaluation of computer-based and other state-of-the-art technologies for purposes of instruction.

Students worked in groups to produce support materials for a larger content unit (for example: a mini-lesson on planet distances to accompany a larger unit on astronomy for 8th graders; or a multi-media presentation on the Globe Theater to accompany a larger unit on Shakespeare's Othello for high school juniors). This support material included a World Wide Web site; a desktop-published paper reference; and a multimedia-authored, stand-alone program. Evaluation was based on the quality of the projects and their accompanying documentation, including usability testing results and "bug reports." Personal journals were kept by each student and submitted at the end of the residency.

Development and Delivery Utilizing Technology is part of Walden's summer quarter, running from early June to the end of August. Although students and the instructor were in contact via e-mail (and in some cases telephone) during the entire quarter, the bulk of the work was accomplished during the two-week residency period. Students were required to attend the residency portion of the course, making use of the computing facilities on Indiana University's Bloomington campus (and staying in IU's dorms, further adding to the "boot-camp" feeling). During the three weeks prior to arrival at the IU campus, students were given the course assignments via Walden's web site and e-mail messages from the course instructor. Prior to arrival for the residency, all students were directed to form groups (with no more than three other students) and to decide on the subject matter for their project.

Using e-mail and telephone to negotiate groups and project subject matter before the residency solved a number of problems. With only two-weeks of "face-time" to accomplish three sophisticated technology projects, students needed as much advance preparation as possible in order to

make best use of their time together. By knowing who their team-mates were and what their subject matter was in advance, the students were able to focus on the technological problems during the residency (they were also able to bring appropriate materials with them from home). The problem encountered with this approach was that the instructor had to carefully monitor the process of team formation and subject choice in order to avoid misunderstanding or inappropriate interpretations of the assignment — although this is true of almost any course, it seems particularly difficult in a distance-learning, asynchronous environment.

The course was developed and delivered using a problem-based-learning (PBL) approach. Students were encouraged to solve the problems of developing the web site, desk-top published documentation, and multimedia-authored program by sharing their expertise and by participation in instructor-led formal presentations and informal mini-lessons. During the residency, students typically spent four hours in a traditional classroom setting learning about various technology and design-process issues. The rest of their time was spent in small groups working in the computer laboratories or in counsel with the instructor or an instructional assistant.

The problems associated with group work naturally include dealing with personalities that may not naturally "mesh" with each other. This can be a particularly difficult obstacle when all group members are highly competent and autonomous within their professional setting. A considerable amount of class time early on in the residency was devoted to group-work processes and suggested procedures. While it was helpful to outline strategies that tend to work well for groups, it was perhaps inevitable that the group process would break down for everyone at some point or another during the residency — problems existed, but (with one exception) proved themselves to be only minor stumbling blocks along the path to completing the projects. Learning to work in groups seems to be an important part of creating technology-based instruction; the intricacy of the work and the amount of person-power needed to create a successful technology-based presentation currently demands a combined effort. Therefore, although the process has its painful moments, the group-based, PBL approach seems to be the most appropriate choice in the delivery of this type of course.

Course Content

Choosing content for the Development and Delivery Utilizing Technology was difficult. The question that posed itself at the outset was, "What skills does a person need to have in order to be considered a competent user of instructional technology?" The decision was to include three broad areas of technology-based production skills: Internet-based communication, stand-alone, personal computer application development, and the development of sophisticated print material. This decision was made based on the instructor's personal teaching experience, not on formal research.

Upon course completion, students were expected to have a working knowledge of HTML development, paper-based design, interface design (with particular emphasis on navigational elements and standard conventions), as well as the standard conventions and concepts currently used in digital media design (e.g. image resolution, bit depth, file type...etc.).

The concepts and protocols of instructional design were the focus of Development and Delivery Utilizing Technology. Students learned and put into practice some of the standard procedures associated with instructional design, including rapid prototyping, implementation of the ADDIE model, usability testing, and formative evaluation. This proved to be one of the most satisfying elements of the course for most students. The concepts are not new ones for experienced educators, but their articulation in terms of instructional design seem to serve as a conceptual bridge between traditional classroom practice and the development of technology-based instruction.

Software and Hardware Considerations

The software and hardware used to complete the projects was chosen with some consideration as to what was considered "industry standard" and what might be most available in k-12 and post-secondary educational settings (Macintosh and PC platforms, using Photoshop, HyperStudio, and Pagemaker — web pages were created with word-processing software, not HTML editors). The goal of the course is not to accomplish technical competency with any one software package, but to understand the underlying concepts of instructional design and multimedia development in order to be able to apply these concepts to any software package. Although students ultimately agreed that this was a sensible approach to their learning, there was some initial concern about using unfamiliar software — a series of mini-lessons on the navigational elements of the various software packages used proved helpful in getting people comfortable enough with the software to allow them to focus on more general concepts.

Conclusion

Few people actually enjoy boot-camp while they are going through it, but it often serves as a transitional experience that gives an individual greater skill and greater confidence. This seems to have been the case for Development and Delivery Utilizing Technology. Observation from the instructor's point of view suggests that the course itself was challenging and stressful for the majority of learners. However, the course reviews were consistently supportive of the approach — students reported a strong sense of satisfaction and increased confidence in their

instructional design skills and technological understanding. Correspondence from the students to the instructor that continue to this day suggest that these in-service professionals are making active use of the skills acquired in Development and Delivery Utilizing Technology, provided that they are in settings that support advanced technologies.

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TELECOMMUNICATIONS: SYSTEMS AND SERVICES

Section Editors:

Bernard Robin, *University of Houston*
Elissa Keeler, *Grace School*
Robert Miller, *University of Houston*
Siva Kumari, *University of Houston*

The articles in this year's Telecommunications Systems and Services section document the continued spread of the Internet into teacher education programs throughout the world. These writings explore the formation of a variety of electronic educational communities and propose innovative methods for integrating online resources into teacher education. Zimmerman and Greene begin the section with a paper that chronicles a five-year program at Appalachian State University. They describe the project in which they have developed an electronic community that links preservice teachers with university faculty and cooperating teachers. This report chronicles the events giving stimulus to the experience, summarizes pertinent findings, and offers insight into the challenges and rewards of such an effort. Pagnucci, Macauley, Winner-White, and Mauriello explore how the growing use of technology for teaching writing promotes increased teacher collaboration. In particular, the authors focus on four types of technology-based collaborations and provide concrete examples by relating their own personal stories of teaching with technology.

Zhao, Worthington, and Ingram describe a program that equipped student teaching interns at Michigan State University with laptop computers for use in their assigned classrooms. The article documents the experiences of these interns as they developed their own sense of what it means to teach with technology, what it means to be a teaching intern in the context of technology use, and what it means to troubleshoot problems with technology. Davis provides a look at how Telematics, a European term for information and communication technologies, is being integrated into the educational system in the UK and several other countries in Europe. She discusses her work on telematics and teacher training and describes the T3 (Telematics for Teacher Training) project which focuses the preservice training of student teachers, the continuing professional development of inservice teachers, as well as the training of teacher educators and library staff working with teachers.

Kanji Akahori of the Tokyo Institute of Technology describes the effectiveness of integrating the Internet into education in Japan. Akahori also points out some of the problems that Japan is facing as it begins to utilize newer forms of communication technology and discusses the research that is investigating the effectiveness of these technological resources and the impact they are having on schools and the school reform movement. In the next article, Madhumita and Akahori propose a functional model of a computer-based instructional system. The authors describe their work on the design and development of new curriculum that uses a Web-based system for collaborative learning and emphasizes problem-based learning.

Clarke recounts the story of the Education Network of Ontario, a province-wide Intranet, that has grown to over 50,000 registered educators, nearly half of the eligible teachers, administrators, teacher trainees and elected education officials in Ontario. McIntyre and Hollon, of the University of Wisconsin - Eau Claire, describe the Virtual Learning Technology Community, a collaborative professional development model that supports K-12 students, K-12 teachers, university faculty, preservice teachers, and instructional technology staff developers at local service agencies as they learn to use technology as a tool for enhancing learning. The vision of the VLTC is to provide assistance to additional PK-12 schools seeking support for improving the use of technology to help students develop competence in (a) finding and evaluating information and ideas, (b) using available learning tools, and (c) communicating effectively. Maney, Brooks and Perry discuss three statewide technology initiatives that aim to infuse technology into K-12 education and set the stage for cultural transformation of teaching and learning in Ohio. This paper describes how one successful project has developed a K-16 telecommunity to encourage the adoption of education technology.

Breuleux, Laferrière and Bracewell describe a research initiative to design and document technology-supported integrated learning communities for the extended professional development of teachers facing the new Canadian requirements for distributed knowledge of technology. Powers and Dutt-Doner ask the question, "Can an electronic communication system hold discussion as effectively as regular classroom communication?" This paper uses the traditional communication model of source, receiver, message, channel, noise and feedback to demonstrate how an instructor can plan effective electronic communication.

Hrabe, Adamy, Milman, Washington and Howard recount how instructors of seven university educational technology courses at the University of Virginia created a Web-based discussion group for their students to engage in online discussions about issues related to the use of technology in education. This article describes a qualitative analysis of the online discourse as it developed and the participants' reflections on the experience. Sivan documents his work with the Lamda Community project in Israel and argues that "knowledge sharing" - the previously argued essence of any "virtual community" - does not fully capture the dynamics of large-scale virtual communities. Instead, he proposes the concept of "knowledge infrastructure" as a more appropriate term to describe the reason why more people use, and will use, virtual communities.

Manchee's article describes a Web site evaluation project used with fourth grade students. The project was designed to teach critical thinking and research skills valuable in using the World Wide Web and was also used to help train teachers who contributed to the final product. Bronack and Kilbane write about CaseNET, a World Wide Web-based learning environment where teachers utilize the latest technologies to form communities of professionals who hone their decision-making skills via encounters with "slice-of-life" cases. This paper presents an evaluation of the practical implications of this technologically-enhanced learning environment, where both inservice and preservice teachers are actively engaged in decision-making, communication, reflection, and analysis of teaching situations. Galloway's paper targets the training of educators new to the Internet and outlines Web applications for teaching. A variety of Internet uses are discussed including the application of Internet tools in traditional classroom courses. The author provides specific suggestions for teachers who want to incorporate the Internet in their teaching.

Dowling, Sanjur and Maciocha present an overview of a museum Web site created by the National Museum of American Art that supports project-based integration of art and technology in K-12 education. Parmley, Hutchinson, and Parmley chronicle the development of a Web site and educational resources for Hovenweep National Monument in Cortez, Colorado. The partners in this project describe how they addressed the needs of electronic Park visitors applied them to the development of an educational Web site that incorporates classroom learning activities and teacher professional development. Davis, Selinger, Soetaert, van Belle and Robin discuss the development of Web Sites, comparing and contrasting approaches to placing educational material online. Overviews of several Web sites are presented that illustrate plans for development as well as issues relating to an international collaboration that aims to create communities of teachers and learners.

Next, Galloway gives his views on designing Web-based courses and presents a model for teachers who want to provide instruction and course delivery on the Internet. This model starts with the beginner level of basic e-mail and Web browsing and progresses to the highest level, becoming independent distance educators. In their paper, Tu, Babione, and Chen focus on the use and design of online survey, enrollment, and examination technology. An online service system designed for students to enroll electronically at the Teachers College, Emporia State University in Kansas is used to demonstrate the basic techniques and concepts for this new area of Web application.

The next two papers deal with the growing use of electronic mail. In the first, Wilkinson and Buboltz point out that most researchers have focused on the potential advantages gained through the use of technology and have ignored potential risks or disadvantages. In this paper, they highlight some of the potential risks of using this communication medium. In the second paper, Soper, Wilkinson, and Von Bergen discuss how e-mail may be abused as a communication technique. In this paper, the authors discuss the prevalence of e-mail, who tends to misuse it and why, and present some recommendations to counter misuse.

Altun continues the investigation of electronic communication in his article that describes an ethnographic microanalysis that focuses on the discourse and how interaction management strategies function in two different chat rooms: Internet Relay Chat and 3-D Virtual chat rooms. Knee and Cafolla discuss how to bring interactivity to the Web. They present an overview of Java, the object-oriented programming language that has taken the Internet by storm and maintain that with the use of Java, the Internet no longer need remain a static communication vehicle.

Gunter and Gunter describe the Federal Communications Commission's E-Rate Discount Program, that will provide $2.25 billion a year in telecommunication discounts to K-12 schools and public libraries in the United States. The paper provides a summary of the major components of the E-Rate discount program and issues two challenges to administrators so that maximum benefits of the E-Rate program may be realized in classrooms throughout America. Finally, Knaak, Lüssem, Spalka, and Sünderkamp of the University of Bonn, conclude the section with a reminder that the Internet is not without its

problems as they write about the issue of computer security in schools. They suggest that protection of a local school network with access to the Internet requires the formulation, implementation and frequent analysis of a school-wide security policy. They argue that in order for such a policy to be effective, teachers need to be involved in the development and the constant enforcement and that computer security should be an integral part of teacher training. Collectively, these twenty-seven papers help tell the story of how telecommunication technology has become part of our jobs as teachers and they can surely assist us as both developers and consumers of electronic information.

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A Five-Year Chronicle: Using Technology in a Teacher Education Program

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At the beginning of this decade a network of electronic mail systems connected most universities throughout the United States and several foreign countries. Colleges of education had begun linkages with public schools to support the student teaching process. Telecommunication tools for collaboration promised benefits for university faculty, student teachers, and cooperating teachers. The Curry School of Education at the University of Virginia was a premier example of an electronic academic village. Their first experimentation with electronic mail began in 1984 as a result of a joint study with IBM Academic Information Systems and the Curry School of Education. Implications and recommendations from this project have since impacted universities and public schools internationally (Bull, Harris, Lloyd, & Short, 1989).

Appalachian State University (ASU) is one example of an electronic community founded on the piloting results of studies similar to that conducted by Bull and his colleagues at the University of Virginia. In the past few years our research group has reported widely on building a technology-rich community of learners. We have found that our electronic community provides clear advantages for both public schools and our teacher education programs. For the first time we have linked preservice teachers with university faculty and cooperating teachers.

This historical account chronicles the uses of technology in the field experiences of our teacher education program. The purpose of this chronicle is twofold. First, the implementation of this program needed to be reviewed so that others may learn from the process of creating such an electronic community. Second, technology must be carefully integrated and used within teacher preparation programs.

Concurrent Impetus for Change

Throughout the last decade teacher preparation has undergone a "quiet revolution" in response to radical social and economic transformation (Darling-Hammond, 1996). Being apprised of this information, ASU reviewed practices and compared them with state and national licensing standards and ultimately with what students learned and what they could do as a result of their experiences in school. From this information, a university cohort of faculty began to grapple with field experiences as a logical place to begin major changes needed in the teacher education program. Central to the commitment was the desire to thoughtfully transform the teacher education program into a community of inquirers who come together to examine the aims of education and the nature of teaching and learning for achieving worthy educational goals. Technology surfaced as a natural tool for transformation.

Preservice teacher training programs have acknowledged the emerging contributions of educational psychology and technology. A combination of philosophy and technological innovations is critical information in understanding the potential to reinvent a teacher preparation program. Neither a community of learners nor technologies can effortlessly transform education. A combination of both is necessary to create a powerful opportunity to change the structure of public school education and teacher preparation.

Theoretical Framework

The Reich College of Education (RCOE) at ASU has become a participant in this "quiet revolution" with the goal of reinventing itself in terms of mission and work. Teaching is currently defined as a dynamic, goal-oriented social activity which reflects a commitment to both the value of cultural diversity and to the identification and solution of social problems. Learning is seen as an active process of acquiring, assessing, and producing knowledge in an environment of care and respect for others. New forms of learning and teaching can be acquired through experimentation and the exploration of new technologies.

The framework of social contructivism serves as the research base for college reform. Vygotsky's socio-cultural approach affords us the support to guide the process of transformation. Two key implications for ASU were drawn from the literature on social constructivism. First, it is

imperative that we assess the space and interactions where assistance from others occurs as preservice teachers enter the field. Second, hands-on experiences, which can only occur externally or socially, must be perceived as scaffolding in the gradual internalization and the ultimate development of an expert teacher. Both require social interactions or a community of practice (Lave & Wenger, 1990). The concept of interdependence of context, people, and process are integral to the development of teachers (Rogoff, 1994).

Model Clinical Teaching Program

The story of this technological force and the projects developed from it, which brought about change in the RCOE, began in 1992 with a small project called the Model Clinical Teaching Program. The goal of this program was to apply "several technological innovations and procedures that could revolutionize the way in which interaction took place between the university and the schools, professors and teachers, and professors and student teachers" (Blanton, 1992). To develop a basis for a new college model of teaching and teacher preparation, particularly for methods courses and field experiences, the RCOE surveyed and interviewed teachers in the region for guidance. The results of these surveys pointed out the need for increased communication between teachers in the school system, methods professors at the university, and preservice teachers attending college classes and field experiences.

A pilot section of one field experience served as a setting that encouraged preservice teachers to discuss, analyze, evaluate, and interpret their experiences in the schools with professors and teachers. A "Thoughtful Community of Teaching, Learning, and Technology" was created to build a partnership between the public schools and the university in the preparation of preservice teachers. E-mail was employed to link these three groups together for improved communication and increased understanding of expectations in the clinical setting. Funding was obtained from AT&T, Bell South, and the university to utilize an Integrated Systems Digital Network, permitting full video, audio, and data transmission over telephone lines. Public schools in this partnership were equipped with a technology room containing 8 to 20 microcomputers and a multimedia terminal. All participants were trained in the use of e-mail and videoconferencing. Participants were cohorts of preservice teachers in their senior elementary education field experience (Blanton, 1992).

Once the equipment was in the schools, another pilot project was initiated. These preservice teachers were "teaching fellows." This group of students was on full scholarship for high academic achievement and their commitment to the field of education. They were college sophomores and juniors and were mandated to complete one year of tutoring students in the public schools. These participants were required to write e-mail entries at least once a week to their professor who was supervising their experience. Entries were responded to on a daily basis by their professor and careful records of all e-mail transactions were kept for later analysis (Zimmerman & Blanton, 1993).

Year Long Block-Elementary Education

From the two pilot studies it was obvious that increased communication could occur with the use of e-mail and videoconferencing. After additional research and study of our own college practices, five concerns came to light in our field experiences. First, university supervisors, cooperating teachers, and interns were having difficulty communicating and understanding the expectations of clinical experiences. Second, the supervisory process did not seem to facilitate interns' application of formal concepts to the real world of teaching or the construction of meaning from the everyday practice of teaching. Third, interns seemed to reject formal knowledge acquired at the university early in their teaching experience. Fourth, university faculty and cooperating teachers did not share a common body of knowledge and language. And last, the structure of clinical teaching experiences prohibited the social construction of knowledge (Blanton, Thompson, & Zimmerman, 1993). Given these concerns, a cohort of faculty began to examine current practice and from this it became evident that our traditional field experiences needed restructuring.

In the fall semester of the 1993-94 academic year, 16 students and five faculty members launched an experimental year long training project. Each of the four participating schools had a computer lab and was connected to the university's local network. Students were required initially to send two messages per week via e-mail. Listservs were set up for all subject areas for preservice teachers, cooperating teachers and for university faculty to participate in topical discussions and information sharing. Data in the form of e-mail were collected over the course of the semester and archived for analysis. All participants received training in telecommunications. Faculty members taught courses in content methodology curriculum and media and learning. During the first semester students were engaged in these courses for ten weeks and then were assigned to five-week internships in nearby partnership schools. Preservice teachers intermittently returned to campus for seminars, which focused on issues such as classroom management, mainstreaming, strategies, and technology. During the second semester of student teaching students attended periodic seminars and workshops. Videoconferences were also held between and among faculty, preservice teachers, and cooperating teachers. University methods professors continued to communicate with students throughout the year primarily through telecommunications.

At this point, it was obvious that pilot projects using technology to increase communication were promising and that the concept of a year long experience in one setting with the same support personnel was advantageous. During the third year of this experimental project, faculty began an

in-depth look at the interactions within the partnership. Notes conferencing was utilized for specific topics in university methods classes. E-mail was designated for the discussion of concepts, issues, and reflections related to communication skills, social studies, math, and classroom management during the internship and student teaching. Listserv entries were analyzed for discussion of critical concepts taught in the methods courses. These discussions were also examined to determine declarative, procedural, and conditional levels of knowledge. Connections between concepts and application in the classroom were also noted (Greene & Zimmerman, 1996).

Faculty began training preservice teachers as active consumers of the Internet and then followed the effects of Internet use into the regular classroom during the 1994-95 school year (Zimmerman & Zimmerman, 1996). The training enhanced lesson and unit planning and provided a medium for researching specific topics within the state mandated curriculum.

This same year, the North Carolina State Education Department created technology competencies for all preservice teachers. We started analyzing the year long block group of preservice teachers to measure their technological competence in comparison with state guidelines. This was completed through questionnaires and self report (Zimmerman & Zimmerman, 1996). Deficient competencies were then targeted for remediation.

Summary of Findings

Initially e-mail discussions were unstructured and substantiated previous studies which had found that student teachers used technology more for exchange of social and emotional support than exchange of ideas (Thomas, Clift, & Sugimoto, 1996). In an early investigation, e-mail discussions were categorized into responses to class assignments, socio-emotional exchanges, housekeeping queries and bulletins, and spontaneous sustained exchanges of ideas (Schlagel, Trathen, & Blanton, 1996). Findings indicated that e-mail facilitated the creation of active social context in which professional conversation led to professional growth.

To encourage more focused discussions via telecommunications, use of listservs were guided by faculty in the following academic year. Critical teaching concepts were targeted for development. Those included were: Instructional Goals, Learner Characteristics, Curriculum, Classroom Management, Allocation of Time, Instructional Strategies, Instructional Materials, Grouping Practices, Lesson Presentation, and Assessment. A strong knowledge base for the declarative and procedural levels of instructional strategies was evidenced by journal entries. The concept of classroom management was clearly a concern in their preservice development as teachers. The need to develop and link declarative and procedural with conditional knowledge exists in preservice teacher training programs. Reflections and dialogue provided ongoing opportunities for these concepts to be discussed and examined. An electronic community not only eliminated the isolation of teachers; it also created a forum for problem solving (Greene & Zimmerman, 1996).

During the first two years, cooperating teacher's participation was extremely limited. Individual training and encouragement was given by faculty to increase participation. Limited time and desire for personal contacts were cited as reasons for their reluctance. Currently, this participation has increased but is still inconsistent and less interactive.

New and emerging technologies continued to be incorporated, as they became available. In addition to listservs, notes conferencing, web authoring, World Wide Web boards, video-conferencing, and Internet searches were incorporated into the preservice training. When surveyed, the majority of the graduates of this program have noted that e-mail and word processing are the two major technological skills they obtained. The preservice teachers did not feel competent in other areas of technology. When a similar survey was given to the cooperating teachers in this program, teachers listed many more areas of technology in which they were competent. The attitudes of these preservice teachers were positive toward technology. The hindrances, however, were listed as limited funds, equipment, and time (Zimmerman & Zimmerman, 1996).

Implications

University professors have archived a wealth of information in the form of e-mail discussions, preservice teacher portfolios, professional publications, and faculty anecdotal notes. We have learned over the past five years that with careful preparation and facilitation, telecommunication tools are well suited for constituting social arrangements that enable students to jointly construct knowledge about teaching. This application provides rich opportunities for students engaged in internships and student teaching to discuss how they are making sense of everyday classroom experiences. Discourse of this kind becomes a tool for reflection and the creation and restructuring of knowledge about teaching. Further research aimed at demonstrating the effects of these applications on teacher preparation programs is needed.

An ongoing struggle in our college is to increase participation by cooperating teachers in this program. There may be little incentive for expert teachers to publicly reflect about teaching on a listserv. As Bull and colleagues wrote, "Benefits must also accrue to users from the public schools if use of the network is to flourish" (1989). He elaborates on potential instructional benefits for teachers in the public schools. Somehow our communication of these benefits has fallen short of effecting the cooperating teachers in this program.

Increased use of technology must be infused into our methods courses. The value of technology needs to be continually addressed. We found that classroom teachers were using more technology in their classrooms than our newly trained preservice teachers. This may be due to the fact that preservice teachers have less experience in education in general and do not have the necessary skills to adequately integrate the use of technology into their teaching at an early stage. More research is necessary to identify the reasons behind this phenomenon (Zimmerman & Zimmerman, 1996).

To summarize, with easy access to a network and a true social and instructional community for support, we have created an environment for teachers, students and university faculty to grow and explore. Factors essential for success – such as support, leadership, and funds – have been included in our plan. The application of technology has not replaced the special teacher-student relationship, but has helped redefine and strengthen it. Increased participation in this project is warranted and further research must be carefully planned for the future.

Current Participation

Where are we today? We have established an electronic community. We have connected our university with local public schools and other universities, creating a network where teachers, students, and university faculty can become full participants in shared pedagogical dialogue and activities. In this community of learners, we have multi-level, multi-skill membership. Experienced educators collaborate with new teachers, enabling their induction into teaching in a non-threatening atmosphere. Dialogue among participants creates a community where all members learn as they participate in practice. Throughout courses, the university faculty structures telecommunications activities to help students connect abstract university classroom knowledge to their public school experiences. Assistance in the application of technologies is also a common practice in this program. We believe that a key role for university faculty in these partnerships is to help public school teachers and preservice teachers learn to use telecommunications and other technologies by using them together. It is through participation in shared activity that learning best occurs (Zimmerman, Greene, Schlagal, Trathen, & Blanton, 1997).

When our new RCOE model for teaching and learning was implemented this year, our technological innovations were right on target. Faculty had started a serious transformation that reflected the current knowledge base on teaching and learning. With the aid of technology, we had started to use community collaboration as an asset in creating a quality learning experience. The disparity that exists between theory and practice was minimized. The goal of preparing teachers in this type of partnership can link state-of-the-art practice for preservice teachers with state-of-the-art preparation and induction for teachers (Darling-Hammond, 1994). Here a collective knowledge base will be the norm for our graduates who can learn by doing and ultimately develop a strong repertoire for understandings about practice.

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Teachers, Technology, and Teamwork: Stories of Collaboration

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Traditionally, teaching is lonely work. Collaboratively taught courses are the rare exception, not the rule. Teacher's draining schedules leave them little time for meeting with colleagues to discuss new ideas or pedagogies. Worse, departments are often fueled by a fierce spirit of competitiveness and protectionism. And professional conferences, where there are some opportunities to talk with colleagues, are too short for establishing truly meaningful teacher communities.

The World Wide Web, however, offers a new way to bring teachers together. Even with our doors closed, the Internet can take us in and out of each other's classrooms. It is these new possibilities for teacher collaboration which we would like to focus on in this article.

Like many institutions, for the last few years Indiana University of Pennsylvania (IUP) has been integrating information technologies into its educational efforts. In particular, a handful of IUP English teachers have begun using new technologies to teach writing: technologies like electronic mail, desktop publishing, and Web page publishing. These technologies offer many benefits to developing student writers. They give students new tools to use, new ways to work and think, and new audiences to reach.

Yet perhaps more importantly, as individual teachers have worked to bring new technologies into their classrooms, they have found themselves forming new teaching partnerships. These collaborations usually start out the same way, with requests for help: "How do I get e-mail accounts for my students?" "How do you put up a Web page on the campus system?" "Have you got a set of directions for scanning images?" Mastering technology requires us to learn from each other, since few teachers can figure out all the potentials of an educational technology alone. Thus, one dimension of technology collaboration is teachers working for mutual assistance.

Trading technical information is, though, usually just the beginning. At IUP, composition teachers who work with technology frequently also make these sorts of statements: "Have you seen the Web pages my students wrote?" "Look at this magazine my class produced." "Let me forward you this paper review a student e-mailed me." Most teachers love to show off their students' work, and the new technologies at our disposal make such showcasing quick and easy, thereby providing another avenue for collaboration.

In addition, using new technologies seems to consistently bring us into each other's classes. Again, such collaborations start simply: "I'm showing my class how to write Web pages on Thursday. Can you give me a hand?" "If you help me with the e-mail workshop, I'll show your class how to do the PowerPoint presentations." Since the difficulties of teaching with technology are well known, experienced technology teachers are much more willing to lend a hand because they know the favor will be needed in return. Again and again, both at IUP and elsewhere, we have seen teachers who use technology regularly working together, something quite rare for most other teachers.

Finally, new technologies encourage us to link our classrooms. At IUP, our students regularly read the Web pages written by students in other class sections. The students also converse over e-mail, trading comments on rough drafts of papers. Students hold meetings in chat rooms and MOOS. And one of our most exciting new projects is connecting our students in Western Pennsylvania with writing students in other states.

Technology can be the catalyst for a broad range of teacher collaborations. Those collaborations have multiple dimensions, from simple question answering to active co teaching. In the following sections, we offer four different stories of collaborative teacher work sparked by technology. In a variety of ways, the stories reflect the common

threads we've outlined above. They also provide some descriptive accounts of the nature of collaborating with technology. It is our hope that these stories will help other teachers learn to view technology as not simply a new pedagogical tool, but as a means for ending their solitude.

Gian's Story

"My printer just died and I have to get this proposal in the mail by two o'clock. Can you help me?"

"Sure," I said, "let me see the disk."

When you teach with technology, you get these kinds of requests a lot. People learn to come to you for help, and if you're successful, they keep coming back. When I first came to IUP, most of my early technology work for the English department was acting as a trouble-shooter. People would ask me how to convert files, fix printers, and solve network problems. As I gradually met other people who were technically savvy, these help sessions began to work both ways. I am grateful to more than one colleague who spent an afternoon with me trying to reboot a crashed hard drive.

Still, without the Web, most of my collaborations would probably have remained at this level, as problem solving and the occasional gripe session about troublesome software upgrades. But then one day I attended a workshop about creating Web pages. The woman in charge of the workshop, a computer science professor, did a nice job explaining the basics of HTML Web programming, and after a couple of hours I had a home page with my office hours and a few cartoon images.

Before long, I found myself teaching my students how to put their writing online, and after that I was being asked to give guest workshops for other teachers' classes. The Web thrills English teachers because it offers such a cheap and simple way to publish our students' writing. A partnership with William Macauley led to the development of a technology-based first-year college writing course that included e-mail, desktop publishing, and Web work for students. Later developments involved sharing drafts via e-mail and critiquing students' papers online. I learned more manageable Web page authoring techniques from Tammy Winner-White and high-level coding skills from Nick Mauriello.

In the past few semesters, I have begun to write, publish, and present with these and other colleagues about the theory and practice of teaching with technology. A current effort I am involved in is linking a group of technical writing teachers with a class of technical writing students for a series of Web-based documentation projects. Of course, I still get asked how to unjam a computer printer from time to time, but these days that tends to be just the beginning.

Bill's Story

"You know you can change your e-mail name, Bill," Nick Mauriello said. There's some kind of weird tech-lovers' club that forces its members to say things like that. The address Nick was referring to was on 500 business cards I had just purchased.

"Really?" I thought back to the professor who had tried to modify my login.com file and had accidentally locked me out of my e-mail account for several weeks. I also thought about the fellow graduate student who came to my house and helped clean up my hard drive after I told him about the error messages I kept getting from my Web browser.

"Yeah, it's really simple. Just type in 'make me' and then I'll show you what to do from there," Nick said. "'Macauley' is a much nicer e-mail address than 'TGZD.'"

I have been learning a lot about technology since I came to IUP in 1994. I have taught in computerized composition classrooms since 1991, and that had brought about collaborations with many teachers who were curious about technology and with tutors who were willing to help me. In fact, ever since I became interested in using technology in my teaching, I have been helped by people who knew what they were doing already, or at least knew more than me.

"If you want your students to do Web pages, you could use Tripod," Tammy Winner-White said. I had been telling her of my frustrations trying to teach students to write HTML code.

"What's Tripod?" I asked.

Tammy walked me through the acquisition of a Tripod account and helped me start my first page. Eight months and three completed Web pages later, I now have several sections of first-year writing students using Tripod to easily make great Web pages.

One of the best examples of collaboration via the Web is the work I have been doing with Gian Pagnucci. We started teaching collaboratively over a year ago. My dissatisfaction with my teaching and his technological know-how were a perfect match. Gian's knowledge and expertise with the Web was contagious, and out of our collaboration has come, directly and indirectly, 19 individual publications, 11 presentations, five editorships, and seven different workshops.

Other teachers are now even beginning to identify*me* as a member of the tech-lovers' club. Not only have I shared my new knowledge of technology with fellow colleagues, but I have also taken my work off-campus to several local organizations. Along with all the sharing of expertise which takes place when learning about technology, I believe there

is also a sharing of excitement over the possibilities for teaching in these new virtual worlds. That excitement tends to be pretty infectious.

Tammy's Story

"So what's this workshop about?" I asked Nick Mauriello.

"I'm doing a workshop for faculty on how to make Web pages."

"How many people will be there?" I asked.

"There are 23 signed up so far."

"I bet you could use some help."

In the four years that I have been teaching English at the college level, I have experienced many different levels of teacher-to-teacher collaboration. One such example of this dynamic interaction occurred during the fall of 1996. I was a beginning Ph.D. student at IUP, and upon my arrival I made it clear to the program director that I was interested in the ways written communication could be expressed in electronic forms. I also kept bringing up technology issues in the graduate courses I was taking. During the fifth week of the semester, another Ph.D. student, Nick Mauriello, was asked to give two workshops, one for students and another for faculty, on how to build a Web page using the IUP's VAX system. I had a feeling that it would be hard for Nick to manage this task alone given that all of the workshop participants were new to the VAX and to HTML code, so I offered to help. These two workshops perhaps proved to Nick and I that two heads, and two pairs of hands, are better than one when teaching students and faculty how to write HTML code on a Friday afternoon (especially technophobic faculty members). Because we were both able to collaborate to solve minor and major problems that day, the workshop was a success-and the first of many to follow.

After that workshop, one of the faculty members who had attended asked Nick and me to act as facilitators for his summer course titled "Technology and Literacy." Once again I found myself volunteering to help another teacher use technology in the classroom to facilitate a writing process. Although I was in a class of my peers, I found that I was constantly roaming the room to put out "technology fires" so that the teacher of the course could focus on the material he wanted to discuss. On more than one occasion, the teacher of the course consulted with Nick and me on the best way to approach class activities which introduced the Web, chat rooms, and MOOs. During the second summer session, another faculty member, Gian Pagnucci, asked me to come to his undergraduate class on a day when his students were building Web pages. It seemed that the class was happy to have more than one person available to help address individual questions about doing HTML authoring. It was also at this time that Gian and I started to explore the best ways to teach Web page authoring in English classes.

More recently, two weeks into the Fall, 1997, semester at IUP, I was given an unexpected opportunity to teach two sections of college writing in a networked computer lab. Since I wasn't appointed to teach these courses until after the semester had begun, I had to rush to put together a course syllabus and materials. But I found that Nick, who was also teaching two sections of writing courses, was more than willing to help me design my course even though I only had day before I was to start teaching. Nick invited me over to his house and we discussed the ways he was using the Web, e-mail, and chat rooms in his classes. Nick suggested that I adopt his course outline, and join him as a participant in the College Writing Peer Response Project, a project he had designed for students to publish their writing on the Web and solicit peer reviews from a national audience. Without Nick's help, I could not have walked into this class (already two weeks behind) and given my students the full [illegible] of writing in a networked lab. A willingness by teachers to share ideas, talents, and materials with each other has been, for me, the key to promoting electronic literacy.

Nick's Story

"Oh, do you mind?"

I was talking to the director of our graduate program when a flyer on his desk caught my attention. The flyer was advertising a departmental forum on using technology within the Rhetoric and Linguistics Doctoral Program at IUP. A quick glance told me that the use of e-mail, Web sites, and PowerPoint were on the agenda, nothing too surprising. What did surprise me was seeing my name listed as one of the session's facilitators!

"What's this?" I asked.

"Oh, do you mind?" was the reply. Well, of course I didn't, and together with Tammy Winner-White, we initiated yet another 25 academics into the cyberclub.

To some, "do you mind?" may seem brazen or offensive, but not to me. As an instructor who pushes technical literacy, I have positioned myself into a unique corner of the institution. Along with other "techno-colleagues," William Macauley, Gian Pagnucci, and Tammy Winner-White, I have become accustomed to the "do you mind?" syndrome, and have come to interpret it as "Can you help me here?" Technology can be frightening, especially to many academics who feel institutional pressures to bring technology into their classrooms, but don't know where to turn for help. The natural source for this help should be one's colleagues who are already successfully using the technology.

I taught in traditional classrooms the first five years of my career. I planned my lessons at home, graded papers alone, and very rarely consulted with colleagues about my pedagogy. I never knew what my colleagues taught behind their classroom doors and they knew just as little about what I did. I came to believe that this was the proper structure for higher education, and worse, I accepted it.

Fortunately, though, technology has changed that. I now regularly give workshops on Web page creation to faculty and students. I have helped out in the classrooms of my colleagues, especially my "techno-colleagues," Gian Pagnucci, William Macauley, and Tammy Winner-White. Gian and I even put together a proposal for an IUP Center dedicated to the Advancement of Web-Based Teaching and Technical Literacy. And one of my most exciting initiatives has been designing, building, and administrating the College Writing Peer Response Project. This Web site is used to post student papers and solicit critical revision comments from outside readers. I created the site as a way to link my students at IUP with the students of fellow teachers in Alaska, Minnesota, and Kansas. Since the site was first created, we've received over 1200 responses.

The social dimensions inherent in using technology in the classroom have ended for me the loneliness of teaching. I now collaborate with colleagues both on and off campus. As our friendships have bonded, we have been able to push each other professionally. Together, we present at conferences and publish articles. We have managed to open the doors to each other's classroom and in doing so we have built a community of scholars that gives us pride.

Academic Collaborative Exchange (ACE)

Because all four of us believe so strongly in the benefits of technology-fostered collaboration, we have begun developing a Web site called the Academic Collaborative Exchange (ACE). Our idea is to create a space where teachers can find resources to facilitate collaborations, technological and otherwise. The site will describe collaborative projects on which ACE participants are currently working, provide lists of names of teachers interested in doing collaborative work, and highlight scholarship on the subject of collaboration. We also hope to eventually hold an annual collaborative conference where people can come together to work on tackling key issues of teaching with technology. For more information, please visit our ACE Web site at:
http:\\gradeng.en.iup.edu/pagnucci/iup/ace.htm

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What Student Teaching Means to Me: The Introduction of Portable Computers into a Teacher Preparation Program

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The technological changes taking place in society have implications that reverberate throughout entire social systems. In education, for instance, institutions of higher learning and other organizations that represent academia struggle with devising optimal methods for implementing technology meaningfully, just as do teacher preparation programs and practicing and preservice teachers. Indeed, as more and more parents clamor for meaningful educational technology experiences for their children in the classroom, those who research the work teachers do and those who prepare them to do this work must also devise ways to support teachers as they incorporate the use of technology into this work. Programs such as the Apple Classrooms of Tomorrow (ACOT, 1997) are designed to address these issues, but the work is far from complete.

Indeed, the incorporation of technology into education is not a smooth, linear enterprise, but rather is characterized by fits and starts as individuals come to terms with what technology and teaching with technology truly mean to them. It is likely that most every teacher and preservice teacher today has some sense that technology is becoming an integral part of what it means to be a teacher—especially a newly-minted teacher—even those who have not had many or any direct encounters with technology. Even teachers who are complete technology novices have likely developed expectations and assumptions about the meaning of technology use in the context of the classroom. But what happens when a novice teacher is faced with technology in the context of her classroom for the first time? How, if at all, does she find it necessary to adjust her beliefs and assumptions in interaction with the technology? How does the use of the technology in the classroom context interact with her beliefs about the nature of teaching in general? Further, what impact does the use of the technology have on her perception of the way to carry out the duties of her teaching?

The Laptop Programs: A Site for Studying What It Means to Teach with Technology

A program in the college of education at a large, midwestern university offers ways to think about examining some of these questions as it simultaneously attempts to structure the teacher education experiences of its students with respect to technology. In keeping with the university's commitment to helping prepare its teacher education students to work in technologically sophisticated classrooms, the program distributed laptop computers to two groups of roughly 90 preservice undergraduate teaching interns each, for use in the public schools in which they were student teaching. The laptops were equipped with e-mail and web capabilities, as well as word processing and spreadsheet applications. Orientation sessions early in the semester provided an opportunity for the researchers both to distribute the laptops to the interns and to collect baseline data about the interns' demographics, computer experiences, and expectations about using the laptops in their internships.

The orientation of one group of interns was heavily influenced by the assumption that the interns should use the laptops to improve communication among themselves, their cooperating teachers (CTs) in the classroom, and the field instructors (FIs) who served as liaisons between them and the university while they were in the classroom. Modes of communication have long been at issue for these triads, and the project leaders believed that the communications capabilities of the laptops could help the involved parties maintain better lines of communication among themselves. Thus, the orientation for this group of interns was focused toward this end. For instance, during the orientation, teaching interns learned how to send e-mail, specifically e-mail attachments, the idea being that they could share lesson plan ideas and examples with their CTs even when they were away from the classroom. The orientation also encouraged intern-CT co-planning by highlighting the features of a word processing application that enables users

to add comments to drafts and distinguish their own comments from those of other users. Further, this program's emphasis on communication also manifested itself in the fact that in many cases, the intern's CT also attended the orientation, pairing up with the intern so that they could both become acquainted with the laptop and its capacities to support their communication and sharing.

The orientation of the other group of interns was markedly less focused. These interns also experienced an orientation that introduced them to salient applications and features of the laptop, but while the first group's orientation focused specifically on communication needs, the second group's orientation was designed to help students think broadly about using the laptop in their internship experiences. In other words, the second group of interns basically had carte blanche to use the laptops as they saw fit to help them with their internship duties.

Further, whereas in the first group the program was designed so that all of the CTs, FIs, and interns would share the laptop among themselves and possibly with other triads based in the same school, in the second group each secondary intern received his or her own laptop and was not directed to share it with anyone else. At the same time, however, several groups of the elementary interns were assigned only one laptop, and they were not given specific instructions regarding the expectations of their sharing practices. (It will be interesting to compare the sharing practices of the first group to the sharing practices of the elementary interns.)

Thus, a comparison of the ways these different groups of interns chose to use the computers to support their teaching once they actually had them could help us begin to understand the processes by which novice computer-using teachers coordinate their initial understandings of teaching with technology with their actual experiences in doing so. The different instructions for each group provide a contrast between more typical, directive teacher education programs and an approach that allows interns to be more exploratory and creative by deciding for themselves how they would like to use the technology to support their teaching. Thus, in addition to the baseline survey data, the researchers have begun collecting data by observing the interns engaged in an "authentic" task. Namely, the researchers are assisting interns in one-on-one troubleshooting sessions as interns discover and try to address minor or major laptop malfunctions that are hindering their use of the technology for teaching. Through conversations with the interns around these specific computer problems, the researchers are beginning to uncover their more general experiences with the laptops in the context of their teaching. It is the belief of the researchers that such a study is relevant to teacher preparation programs seeking to turn out technologically-capable teachers and the public schools seeking to hire them, because the findings could illuminate the strengths and weaknesses of both a prescriptive and an open-ended mode of preparing future teachers to teach with technology.

Preliminary results of these conversations indicate that within the first group, interns in some schools are indeed using the laptops to enhance their communication and co-planning with CTs and FIs, e-mailing attachments and using the word processing applications in ways very similar to those modeled in the orientation. However, interns in other schools are not using the laptops much at all, and when they are, their CTs are decidedly "out of the loop," either demonstrating reluctance to use the laptop or not having any awareness that they are still involved in the laptop program. It appears that interns who are actively using the laptops have been placed in schools that themselves are equipped with ample technology. In addition, the CTs in these schools have their own personal computers at home. Interns seem to be less active with their laptops in schools that are not as well equipped with technology.

In the other group, a similar situation has occurred. Much of the interns' usage of the laptops for teaching or education-related purposes is strongly influenced by the CT. Just as in the first group, interns that have been placed in technologically equipped schools are expected to utilize the technology by their CT. Other interns who have been paired with CTs who are not accustomed to using technology are being discouraged from using it. During a conversation with an intern, it was revealed that one CT preferred calling interns to using electronic mail to discuss lesson plans or general classroom issues. There hasn't been any evidence yet that revealed an intern encouraging his or her CT to incorporate technology into the teaching practices. However, there has been an instance in which the CT was dismayed by the intern's lack of computer skills and strongly encouraged this intern to become more knowledgeable in this area.

A Site for Studying the Experience of Being an Intern

The laptop program at this university also enables researchers to better understand the experience of being an intern in the context of technology use. Students coming into the internship program and taking responsibility for the laptops not only had to care for the actual equipment, but also had to begin to make sense of how to use it meaningfully. For the interns, this meant developing a sense both of their duties as interns and of their duties as interns who teach with technology. We wondered about the impact of students' interaction with the technology on their generalized assumptions about teaching. Would these assumptions change and incorporate beliefs about teaching with technology? How did the interns reconcile their own experiences and beliefs about technology with their beliefs about the expectations and demands of being a teaching intern?

As both individual "consumers" of technology for teaching and representatives of technology use for a larger culture of teaching, these interns are having to synthesize the different messages they are receiving about technology use and develop their own understanding of what teaching with technology—and in the process, what being an intern—is all about. First of all, much rhetoric indicates that teachers need to use technology because it is a "magic bullet" that can solve many educational problems, despite the fact that the realities of using technology in the classroom are much more complex. As an example of this rhetoric, President Clinton has promised to connect all schools in the United States to the Internet by the year 2000. Second of all, the teacher educators who provided the interns with the laptops have certain expectations about what meaningful uses of technology in the classroom might look like. These expectations are grounded in educational and learning theory, but they are expectations nonetheless, and they are brought to bear on the interns' beliefs and ways of making sense of their experiences. And finally, the interns themselves have brought to the table their own beliefs about teaching with technology and about what being a good teacher entails, not to mention experience of the realities of classroom teaching that may not mesh with either the rhetoric they have heard or the expectations of those who educate them.

Following Vygotsky (1978), in this culture of teaching, these interns must internalize all of these messages about what it means to teach well and to teach well with technology and eventually shape their own understanding of these concepts. Again, conversations with interns can help us access the thought processes of these interns, who are striving to make sense of teaching with technology as they simultaneously struggle to develop an understanding of teaching in general. Preliminary findings indicate that some interns are discovering the ease of completing tasks such as computing grades with a spreadsheet and gathering information to include in a lesson plan by downloading sample lesson plans from the Internet. Other interns are searching the Web in hopes of finding interesting sites that contain information that they can include in their lesson plan. They want to provide the students with an interesting and informative lesson when they teach. This essentially means that the students are becoming aware of the many responsibilities associated with being a teacher and are utilizing technology to simplify this job. At the same time, the interns are taking advantage of the broad range of information that is available on the World Wide Web in order to provide students with a good lesson simultaneously realizing the importance of student engagement.

A Site for Studying the Experience of Troubleshooting Technology Problems

An added complication for these teaching interns involves their physical distance from the supportive community of the university. Before they entered the internship phase of their education, many interns lived or at least spent an appreciable amount of time on campus, where they were surrounded by support for their technology use. A computer store and center, computer lab monitors, and hotline services all helped these interns feel that their technology use was supported and encouraged. As a result, it is likely that few of them had to solve many technical problems on their own; a distributed cognition model (e.g., Hutchins & Klausen, in press) indicates that everything the interns needed to know in order to use technology was spread throughout the system of the university. Despite the fact that they themselves may not have known how to troubleshoot their computer problems, the university setting was responsive to their needs in the form of the support previously mentioned.

In contrast, the internship year takes students out of the university context and places them "in the field," where they spend most of their time teaching and working with their CT in the classroom setting, away from the university. With the physical distance from the university, the interns are in a position of having to relearn how to get the help they need to carry out their day-to-day activities using the computer. The programs that issued the laptops do provide support in the form of hotline hours, handouts of relevant information, and periodic visits from program assistants who can help with troubleshooting at designated times. However, the structure of this support is significantly different from that provided in the university setting; given the distribution of the interns over a variety of schools and school districts, there is only so much continuous support that can be offered to interns who are experiencing "technical difficulties."

Thus, we have been investigating the hypothesis that the interns must become more resourceful and restructure their understanding of the laptop in this less supportive setting. Not only does the laptop become a tool for helping interns teach, but it also becomes an exercise in creative problem solving, forcing interns to rely on each other and their own ingenuity more than would be expected in the supportive university setting. We are interested in these possibilities to the extent that dialogue with other interns and CTs about these specific technological problems could help to spark the kinds of conversations we as teacher educators would like to see occurring among student interns. We hope to see discussions on topics more specifically related to how to be a good teacher or how to teach well with technology. Further, we are interested in the extent to which the technology resources of the school become incorporated into the interns' coping strategies.

Summary

In this paper we have described an attempt to integrate technology into a teacher education program and a set of issues that are worthy of serious investigation. Based on

preliminary data, we have made some suggestions and hypotheses. These suggestions and hypotheses, while by no means conclusive, can serve to frame future studies on technology integration.

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Developing Telecommunications within European Teacher Education: Progress, Plans and Policy

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The Commission of the European Union clearly recognises strategic benefits of extending 'advanced distance learning techniques into schools and colleges' within the Bangerman report. Information and communication technologies (Telematics), one of the 10 key application areas, was noted to provide more efficient, more available education and training better able to meet needs (Bates, 1995). Indeed the central tenet of the European policy toward the information society is that European citizens will have the opportunity to become skilled and highly educated irrespective of location. In Europe, each individual's education is established during compulsory schooling under the guidance of the teacher. Teacher training is therefore high on the priorities of the European Commission. One action has been to fund three Telematics projects that focus on telematics and teacher training within the Telematics Application Programme. This paper is part of the work of the T3 (Telematics for Teacher Training) project which is coordinated from Exeter by the author.

The European Commission used the term Telematics because the term Informatics had been used instead of Information Technology in some European countries. The addition of telecommunications resulted in a change of the term to *Tele*matics. Today it is just as acceptable to use the phrase Information and Communication Technologies (ICT), but as this paper describes much work carried out within the Telematics for Teacher Training project, the term Telematics will be used throughout.

Teacher educators are one body of people who can significantly change education in Europe because their effect is multiplied twice: they educate teachers who educate students who are the future citizens of Europe. Training of teacher trainers escalates this to a cubing of the action (*Training* [3]). Teacher educators who model good practice with telecommunications and information technology with their students and for their own professional development will permit their students to take it on board for themselves. This is the principle behind the T3 project. In each country, we have a partner teacher training institution that contributes to establishment and sharing of good practice, and together, we hope to encourage the growth of communities of practice. T3 partners include eight teacher training organisations located across the European Union: Utrecht University (The Netherlands), Dublin City University (Ireland), IUFM Grenoble (France), The University of Gent (Belgium), Instituto Technologie Didattiche Genoa (Italy), the University of Minho (Portugal) and the University of Oulu (Finland). The coordinating partner is the University of Exeter (United Kingdom).

The T3 Project focuses on the establishment of communities of teachers in four discipline areas:

1. mathematics
2. science
3. languages
4. technology

It is embedding telematics within courses for teachers, both preservice training for student teachers and continuing professional development for practising teachers. There are also strands specifically for teacher educators and library staff working with teachers. Best practice is being established in a distributed and growing network of higher education institutions and partner schools that will welcome opportunities to assist in the growth of community through discussion and demonstration.

The development of practice within each discipline is led by a university in a different European country: the UK, Italy, The Netherlands, and Finland respectively. The French partner teacher education institution also enhances the translations of language and tests the transferability of the courses. We are developing approaches to teacher education which model best practice with telematics, in order to provide an ongoing context for the use of telematics in education.

The T3 project consortium decided that, as the Telematics applications need to be accessible to teacher educators, to disregard satellite and broad-band techniques, except for dissemination purposes. However, it should be noted that the use of satellite telecommunications for

courses has been demonstrated and other Telematics Application Programme projects are working on its feasibility for a variety of purposes. T3 uses two complimentary channels of telecommunications:

1. Internet applications including WWW, E-mail and computer conferencing, and
2. ISDN applications, particularly, point-to-point enhanced video conferencing.

Previous Research

The use of communications and information technology in education is not new and T3 draws upon work developed over the last fifteen years around the world. Veen, Collis, de Vries, and Vogelgang (1994) review a range of communication and information technology projects within and across European countries. The majority describe the collaborative use of electronic mail between schools nationally and internationally. A few provide case studies in teacher education, including some of our early work in Exeter. Osorio (1995) describes a needs analysis performed during an international conference in Europe before the arrival of multimedia telematics. Veen, et al. (1994) attempt to draw out the lessons from these projects to provide a basis for teachers new to the use of electronic communications in education and to policy makers.

There have been significant projects in the Far East and Australasia. Similarly there have been major projects in states such as Florida and Virginia. Ruopp, Gal, Drayton, and Pfister (1993) describe a long term project called LabNet which attempts to develop a community of practice among teachers for supporting each other's professional development across the USA. Companies such as AT&T have become involved in the development of services under the guidance of experts such as Margaret Riel. Attempts have also been made to quantify the benefits of such electronic information and communication services. For example, Riel (1994) provides evidence related to development of the skills that employers wish to see in their new recruits and Davis (1994) provides a cost benefit analysis for ISDN in teacher education.

Others within the T3 consortium have worked in this area for some considerable time developing Telematics networks for education and researching the needs and pedagogy for Telematics in education. Notable are the University of Oulu which uses video conferencing for remote teaching in Finland, ITD which provides curriculum development and inservice training through a number of projects in Italy, Project MINERVA which developed Telematics in Portugal, and the NITEC network which supports teachers in schools across Ireland (described by McKenna in Veen et al, 1994).

The Association for Teacher Education in Europe has also been active in this area. Bob Moon led a research seminar for ATEE's Working Group 6 'New Technologies and teacher education' on this topic in Brugges in July 1996 complimented with a draft paper and literature review (Moon, 1996). The European Commission's Multimedia Report (1996) provides a view of the actions for multimedia and telecommunications in education and training across Europe and has been used to inform more recent policy.

The high hopes for the deployment of Telematics to enhance harmonisation across European culture and to improve European education and training provide the context for this paper and the T3 project's work. It is also useful to note that the need for improved forms of teacher training and a major 'updating' of the teaching force are widely recognised by policy makers and those in industry and commerce. The next section describes what we have been able to develop before considering some successes and stresses.

The Development of Telecommunications within European Teacher Education

Our Telematics for Teacher Training project is in the final of its three years in 1998. By September 1997, we had already put telematics into the courses of over 2,000 student or practising teachers. Two examples of courses illustrate the wide variation in approaches and content.

Courses and Resources for Science Teachers

The development for science has been spread across several partners. The early lead was given to Dublin City University (DCU) where Michael Cotter complemented his co-ordination of Ireland's collaboration in the GLOBE project with T3. The GLOBE project, which is centered in the USA, focuses on measurement of climate by each participating school around the world, with a Web Site disseminating information from both schools and satellites in many forms, including weather maps (http://globe.fsl.noaa.gov/). DCU's approach was to provide a two day course for practising teachers to get them started in using the Internet links to GLOBE and in skills for making scientific measurements. Michael's report (Cotter, Davis, & McShea, 1995) showed that this first approach was not replicable across Europe for several reasons, not least that the focus on detailed daily scientific measurements was difficult to fit into the school timetable and access to the Internet was problematic.

The T3 consortium learned from this experience to take a wider variety of strategies which teacher educators could adapt to their purposes and from which to select resources. It therefore moved on to take three parallel approaches:

1. development and support of an environmental Web site
2. teaching and learning with Biology student teachers
3. structured course for delivery to groups of students teachers

1. **Euroturtle**. This is an internationally valuable Web Site that has been developed to act as a model of good practice and to support environmental education by Roger Poland, a teacher and research student in England. The European turtle is an animal under major threat on Greek beaches in the Mediterranean, even greater threat than the related populations which nest on beaches in Florida. The Web Site provides detailed scientific information about turtles and their habits and information about environmental risks. There are materials and teaching activities for both primary and secondary students, including a multimedia simulation about the laying and hatching of turtle eggs and an identification kit. Students' work is displayed and the Web Site continues to be evaluated and to grow in a suitably organic fashion.
2. **Exeter's Preservice Course with Biology Student Teachers**. Linda Baggott has placed many of the materials that she uses in her course for postgraduate students online. The Exeter model of teaching is on the project's T3Centrum Web Site, along with model lesson plans, student work and discussion forums are in preparation. Linda uses these materials to extend her teaching and reduce the face-to-face taught elements. As Exeter students only study in the university for the first of their three terms, this online material and mode of communication is expected to be valuable. Linda also uses video conferencing (the other telecommunications channel used by T3) for supervision 'visits' with her students when they are on teaching practice in certain schools with this telecommunications facility and for liaison with teacher mentors in that school.
3. **Environmental Education Course** T3's Italian partners are constructing a course which will enable student teachers in multi-disciplinary groups to develop appropriate strategies for teaching environmental education. It is derived from an approach used for groups of teachers across Italy in the Media project (Briano, Midoro, & Trentin, 1977). The course will be led by Vittorio Meddera from Genoa, mainly using the Internet to provide the course materials, discussion groups and collaborative work. Starting in early 1998, the pilot will be delivered to groups of student teachers and their local supervising tutors in three countries. Thus the student will not only learn how to deploy telematics within the teaching of environmental education, but they will have the process modeled for them.

Courses for Teacher Educators

The T3 project has included many approaches to training the trainers. This eclectic style is one that the Telematics Centre first noted when researching professional and organisational development of the use of Information Technology within initial teacher training in 1992, during project INTENT (Davis, Kirkman, Tearle, Taylor, & Wright, 1996). Three of these approaches, some of which are not courses themselves but will influence the design and delivery of courses, include:

1. collaborative professional development
2. online services to teachers in schools
3. a modular course for advanced students

1. **Collaborative Professional Development**. The T3 project participants are, in the main, teacher educators who are undertaking significant action research and developing themselves professionally as they develop courses for others. This is a collaborative learning process as well as a collaborative working process. An early form of our professional development was sharing of our approaches to the deployment of Telematics using a 'needs analysis' structured interview over video conference. Six scenarios were illustrated within the interview process (Davis, McShea, H., McShea J., Osorio, Still, & Wright, 1997). Significant learning also occurs during meetings, writing reports and commenting on other peoples' work. Most significant are probably the online discussion groups which our Utrecht colleagues, who lead the formative evaluation, have designed as 'a virtual workshop' (Lam, Taconis, & Veen, 1997).
2. **Online Service to Teachers in Schools**The Telematics Centre within the University of Exeter School of Education has created a new form of inservice training to teachers directly in their schools using video conference telecommunications. The services are being provided in England and partners indicated that they could find the approach useful in the T3 multimedia needs analysis (Davis, 1997). The technology is used in a point-to-point link from the university to a school and in addition to the voice and video of participants, they share resources on video tape and disk, and put documents, slides and objects under the document camera. The video channel is also used to show live footage of demonstrations or work on the traditional board. Teachers can have an intense one-to-one tuition with a teacher educator in Exeter, or small groups of students can be linked to an expert who extends the curriculum and provides a model for new approaches to the curriculum and to teaching. For example, practising artists are one form of this *'expert in non residence'* service.
3. **A Modular Course for Advanced Students**Several of the T3 universities have masters level courses for practising teachers and a common approach is modular. We are currently redesigning a new set of three modules to take full benefit from the flexibility offered by telematics. The first course, *Teaching effectively using*

ICT,' will be piloted this winter. It will involve groups of between 6 and 16 teachers and trainers in a variety of locations, including the home site in The Telematics Centre in Exeter. The majority of the course will be online complemented with two face-to-face sessions: one at the start of the course on the 14/2/97 and a second one, five weeks later. Students will use the course text (Somekh & Davis, 1997) as compulsory reading material plus other material on paper and material on the WWW. Interactive forms on the Course Web Site within the T3Centrum will be used by the students to build their portfolios and their action research, which will deploying ICT within their teaching. Students will be encouraged to adopt peer tutoring among the group and so model a teaching strategy that has been found valuable within Superhighways for Education projects in the UK. Seminars will take the form of online discussions. Phone and E-mail will be widely deployed for individual contact. All the tutors will share a discussion forum of their own. Tutors will be encouraged to support variations in the course in order to adapt to the needs of the individual teachers and groups, particularly in relation to the discussion of examples of ICT applications and their contexts, including assessment. A second course *'Learning effectively using ICT'* is planned for summer 1998.

The Successes and the Stresses

This paper will now consider the international collaboration uncovering the successes and the stresses. The courses described above show ways in which strategies and resources can be transferred across institutional and national boundaries. Already we are being asked by others can they join in and do the same? The answer is of course yes, you can share too, but actually none of us are the same. Telematics applications are built upon the process of teacher education. None of us have simply applied a T3 like a coat of paint to our courses. To ensure that telecommunications are deployed effectively, the process must involve reflecting on the act of communication within a course, its resources and organisation and changing them to deploy ICT effectively for teaching and learning, including the modeling of good practice.

The majority of T3 courses encourage action research and reflective practice, thus enhancing the quality of teaching and learning. For example, courses for student teachers in Exeter are structured by the Exeter model of reflective practice. Another University cannot simply take Exeter's material and strategies, but it can learn from its approach, just as Exeter can learn from partners' experience and experiments.

The design of the Environmental Education course and the advanced courses described above have been significantly influenced by the trial of a course for student teachers of Technology which was created by our Finnish colleagues and taught over three countries in summer 1997. The Control Technology Course can be visited at http://edtech.oulu.fi/t3/courses/wp13/english/ Interestingly the course was not a universally enjoyable experience, especially noted by Exeter students who were unfamiliar with both telematics and control technology. McShea and Givens (submitted) discuss how this was related to both the technology and the approach. Students had difficulties with the interfaces, which although friendly on the WWW, their central learning task involved both the transfer and integration of files across formats, computer systems and countries, plus control of a model train using programming commands, occasionally with delayed and misleading feedback. Even an expert could have been confused when working at this level. Many of the Exeter student teachers were also telematic and control technology novices. Although they found the tasks uncomfortably challenging, on reflection they commented on how much they had learned and recognised the extraordinary challenges that learners can face and still learn!

In addition to these technological stresses, we find that the approaches and philosophy of teacher education varies with the institution and the country. Philosophies of education and approaches to research and development in teacher education with IT do vary widely, as described by Jerry Willis in his Keynote paper to the ITTE Memorial conference for Brent Robinson (Willis, 1997). He notes that the more traditional empirical approach is complemented today with more qualitative and contextualised views from critical theorists and constructivists. We suspect that our 'constructivist' approach in Exeter (Dunne & Harvard, 1993) is not shared by all of our partners and this may prove the most challenging issue of all.

Further Developments in 1998

I am hoping that our consortium of teacher educators across Europe will understand and continue to respect each others' approaches and philosophies during this last year. Our move to retain telematics within teacher training courses without direct support from the European Commission will undoubtedly cause stress. Should you wish to join and spread this community of practice, please visit the T3Centrum and see where your context and philosophical approach can fit to our mutual benefit.

Later this year we will abstract a core curriculum in telematics for teacher training for Europe and we plan to turn this into a policy document to help ourselves and our colleagues around the world to agree with their policy makers on the importance of strategic planning for teacher training and its wider value to the employers and the community.

Acknowledgements

Telematics for Teacher Training (T3) is supported by DG XIII_C of the European Commission under the auspices of the Telematics Programme. Sponsoring partners include ICL, Olivetti, UK Open University, Dutch Telecom, Telecom Finland, Videra Oy, CET Portugal, Parque National da Peneda-Geres.

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Effectiveness and Some Problems of the Internet Utilization to Education from Overview of School Practice Research in Japan

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The 100-school networking project began in 1993, sponsored by MITI (Ministry of International Trade and Industry) and Ministry of Education, and directly supported and managed by IPA (Information-technology Promotion Agency) and CEC(Center for Educational Computing) and CII (Center for Information Infrastructure). One hundred schools were selected from 1,543 schools applicants. The features of this project can be summarized as follows: (1) one server computer per school, (2) supported by government organization or quasi government organization, (3) supported by local volunteer groups including company engineers, and (4) a voluntary activity plan proposed by each school. This organization is shown in Figure 1.

Many activities were developed by the 100 schools who worked with other schools. These included:

1) Collaborative learning in environmental education such as an acid rain project in which 40 schools participated. The pH of rain was measured at 40 schools and the data were shared by all schools.
2) Report making by enlisting the aid of experts in social studies, in which volunteers answered students' questions.
3) Weather study by connecting to the weather bureau and having students compare weather charts with pictures produced by weather satellites.
4) Cross-cultural education by connecting to overseas schools. This included real time video exchange using CU-SeeMe with a foreign high school and using surveys of topics share information with overseas Japanese schools.

The graph in Figure 2 shows an example of a hamburger price survey in social studies conducted by overseas schools. Children learn economics and social factors by exploring the price of food in different parts of the world.

5) Moral education is addressed using a worldwide questionnaire survey, in which students engage in fruitful discussion about the peace problem based on questionnaire responses about a nuclear experiment conducted by the French government. A portion of the questionnaire is shown in Figure 3. Web-based questionnaires were very effective and more than 2,000 respondents answered from all over the world.

Figure 1. Organization of 100-Schools project.

6) Problem based learning by connecting other schools to a specialist. In one example, a chemical experiment was conducted with input from a professor of chemistry.

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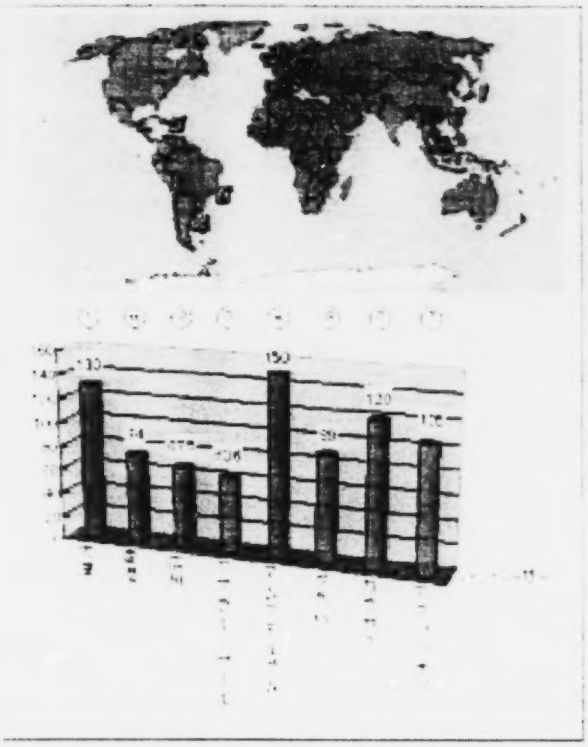

Figure 2. Hamburger price survey study.

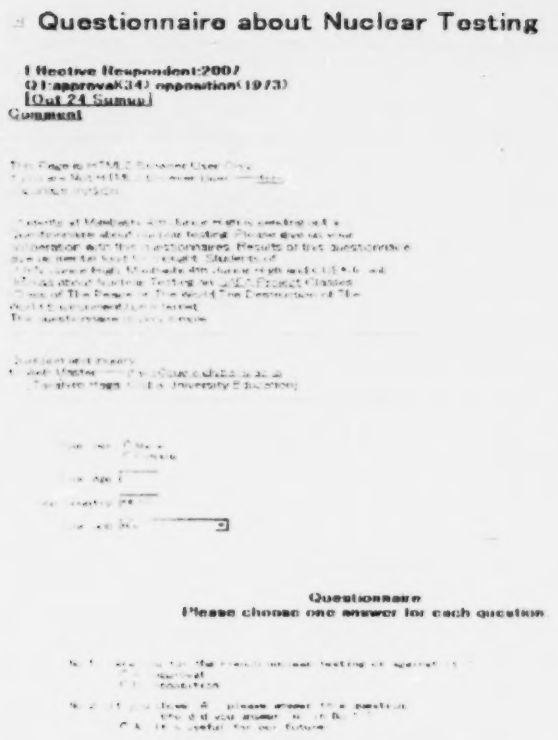

Figure 3. Questionnaire survey of peace problem.

7) Special education for handicapped children was accomplished by developing Web pages. Teachers were interested in this opportunity to open children's minds by delivering their works to the worldwide Internet community.

Consideration of Educational Effectiveness based on Project Research

The impact of the project on schools is summarized below.

Connection of School to Real World

The most significant impact was the change of knowledge resources from a limited school space to expanded information resources worldwide. School resources are mainly teachers and textbooks, and by connecting schools to the real world, the resources expanded widely

by including a great deal of information produced by various organizations and professions. Students could gain new knowledge, and the amount of knowledge changed from fixed to dynamic and alive. School textbooks are released by those in authority and are seldom revised. In contrast, Web pages are produced not only by experts but also novices and are often updated.

Table 1 shows a comparison of resources between school and real world.

Table 1
Comparison of School and Real World Resources

School resources	Real world resources
Teachers	Professionals
Textbook	alive information
Teaching Materials	Learning Resources
Fixed by authorities	Dynamic and changeable by situation
not including harmful information	Including Harmful information

Introducing Wide Area Collaborative Learning

In the information age, individual learning was the important concept in school education, but in Internet utilization, collaborative learning was recognized as important. Participants in the exchange project among Japanese and foreign schools reported that through collaborative learning, students exchange different ideas and different ways of thinking. By exchanging ideas and

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opinions about common topics, they can share different ideas and thinking and also find commonality. This works well for promoting cross-cultural understanding.

Change from Memory-based Teaching to Problem-based Learning

A student centered learning style was realized by accessing information in the real world for problem solving. In order to solve problems, students search and retrieve information related to the problems. It is quite different from memory-based teaching. Also, students return to read textbooks for further understanding of the topic. This means that students can link the problem to the fundamental knowledge contained in the textbook. Students make their own knowledge structure depending on the problem, and it works well in solving other problems.

Change of Teachers' Role

By introducing the Internet to schools, especially for problem solving, the role of the teacher changes from knowledge transmitter to facilitator for assisting students in the problem solving process. However, in order to play the role of facilitator, not only students, but teachersthemselves, are required to act as problem solvers.

Change of Communicating Skills and Computer Literacy

There are remarkable differences in communication skills between old media communication, such as face-to-face or telephone, and electronic media communication via the Internet through such resources as e-mail, BBS or the World Wide Web. Old media communication style requires talking and listening skills, whereas electronic media communication style requires writing and reading skills. Also in the old media style, information is stored in the human memory and is easily removed, such as when it is forgotten. On the other hand, with electronic media, information is stored on a computer disk and cannot be deleted unless one intends for it to be removed. In the old media style, communication was possible only with a small number of people. Conversely, with electronic media, communication with large numbers of people can take place, such as using a world wide mailing list. Therefore, communication skills based on writing and reading will be more important in network age. Practical research demonstrates that students make progress in reading and writing skills through Internet communication, so it is necessary to promote students' electronic media skills as part of their education.

Table 2 shows a comparison of communication skills between old media and electronic media.

Problems and Discussion

Establishment of Social Rules and Manners

Various educators have pointed out the importance of establishing social manners for privacy protection and maintaining interpersonal communication. Many teachers have tried to establish social manners through students' volunteer activities.

Table 2
Comparison of Communication Skills

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	
[illegible]		[illegible]	
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[illegible]		[illegible]	
[illegible]		[illegible]	

Filtering Harmful Information

This problem has been pointed out by many educators and researchers. Technically, it is possible to avoid accessing harmful information. Some researchers, including this author, assert the necessity of network awareness education.

Linkage to School Curriculum

At present, the Internet has been used mainly for promoting computer literacy in Japan. The Internet will be used not only in computer education but also in all subjects. In order to realize this goal, it is important to connect Internet usage to school curriculum, and development of lesson plans together with Internet usage activities and development of useful materials.

Reducing Computer Teachers' Load on Network Maintenance

In Japan, few classroom teachers manage and maintain computer environments as volunteer activities. It is necessary to reduce teachers' loads, for example, reducing teaching time introducing a computer coordinator system where computer specialists are employed.

Enrichment of School Learning Environment

Resources will shift from book-based to electronic media-based. In the future, it will be important to enrich the learning environment in such ways as setting up Internet terminals in school libraries, and adding intranets within schools.

Introducing a New Evaluation Method

The Internet is especially useful in problem solving, and in order to evaluate students' problem-solving skills, new evaluation methods, such as portfolio assessment, will be required.

Self-establishment by Communicating to the Real World

Globalization will spread widely and rapidly in the network age. The Internet will be used in schools more and

more as a communication tool with other countries because this use promotes cross-cultural understanding. It also helps us better understand ourselves and our culture by observing from outside. Self-understanding will lead to self-establishment. How to realize self-establishment through Internet communication in a networked society is an important and challenging educational issue.

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A Computer-Based Instructional System On Problem-Based Learning (PBL) For Faculty Training

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Faculty who use a problem-based learning (PBL) curriculum need to alter their traditional teaching methods of lectures, discussions and asking students to memorize materials for tests. In PBL, a faculty member acts more as a facilitator than a disseminator of information. The faculty's role is to encourage student participation, provide appropriate information to keep students on track, avoid negative feedback, and assume the role of fellow learner. As this role will be foreign to many faculty members, they may have trouble breaking out of their past habits. Therefore, the faculty needs training to develop facilitator skills or they may be unsuccessful in PBL.

In relation to this discussion, the main focus of this paper is on the design and development of a computer-based instructional system for PBL. This system provides online training to faculty for implementation of PBL in order to develop students' metacognitive skills, reflective thinking, decision-making and problem-solving strategies through integration of knowledge and information. The system, as designed, provides guidelines for effective instructional design with appropriate examples for the benefit of the faculty. The present system provides practice in framing problems for PBL.

One of the effective uses of such an instructional system is to support work on a task undertaken collaboratively by a number of dispersed teachers and students where students include trainee teachers. Using this system, the teacher can monitor the progress of an individual learner at any time. The role of the computer is to form mixed-ability student groups based on their prior knowledge and entry test performance, to provide strategies for problem-solving, keep track of all the information collected by the user at different times, and to help organize information for ease of concept mapping, decision-making, and finally, problem-solving. Based on the learner's progress, teachers can provide suggestions and guidance to the students in the form of tutorials and feedback sessions. Students, on the other hand, can hold discussions and seek clarification from each other about any information or ideas. The computer helps in the assessment of performance of each student by manipulating the information obtained from peer review and teachers' judgment. The system is under construction using the HTML programming language and a database designed in Microsoft Access. This system will be implemented using the Internet and interactions will be carried out using 'ActiveX' and 'NetMeeting' software. Regarding future directions, this paper discusses the potential of the present instructional system towards the development of a WWW-based PBL system.

The Functional Model

Based on the background research and design of the present system (Madhumita, Fujitani & Akahori, 1997), a functional model has been envisaged. The functional model of the instructional system (Figure 1) consists mainly of two parts, the Teacher Module and the Student Module. Further, the Student Module is divided into two parts, one for Individual Learning and the other for Collaborative Learning. The teacher is able to access all the input information from the Student Module at any time. The individual learner can access relevant information from the Teacher module when the teacher puts the information on the student's site and also the students can access information from a common collaborative learning area.

Online training is provided to the faculty in different aspects of instructional design, especially for PBL. Similarly learners are given instruction on group dynamics, self-assessment, concept mapping etc. Group formation can be automatically done by the system or it may be done by the teacher.

Evaluation of entry tests are provided by the system based on the preset criterion. The faculty is provided with a list of cognitive strategies to choose from but then they are also allowed to make additions in the database of cognitive strategies. Explanation of each cognitive strategy is given by the system, based on our previous research (Madhumita & Akahori, 1997). The other databases of problem statements, available resources, concept maps, etc., will be created for future reference.

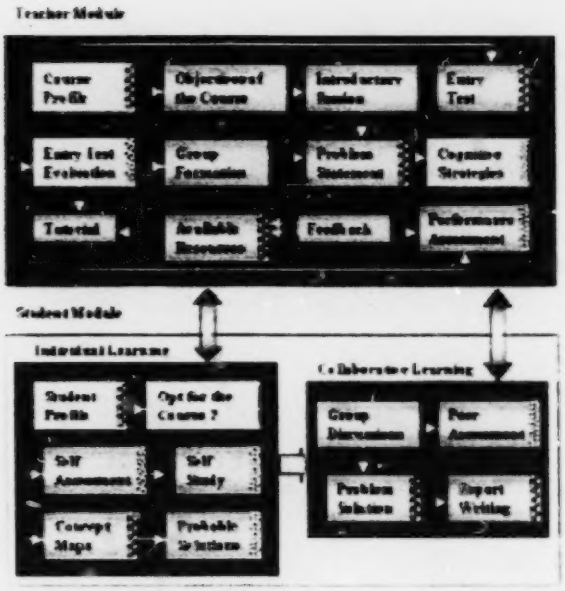

Figure 1. Functional model of the instructional system.

The database of entry test evaluation, performance assessment, etc., will be used only for a particular problem at hand. The teacher provides the course profile and student provides the student profile, respectively. If the student opts for the course after going through the course profile, objectives and introductory session, then only his/her profile information is entered in the database.

Work in Progress

Based on the functional model, we have made progress towards the development of the instructional system. In the Teacher Module, the faculty can get guidance and help on different pedagogical aspects such as: What are learning objectives? How to formulate learning objectives? What is an entry test? What are the different features of good multiple-choice items? What is problem-based learning? In this way, faculty receive online training while implementing a course by using the present system. A screen for the Entry Test in the Teacher Module is shown in Figure 2. While developing the entry test, the teacher can learn more about multiple-choice items or the entry test by clicking the appropriate link.

Similarly, in the Student Module, students/student teachers not only get the information on the subject matter but they also learn such about issues as concept mapping, self-assessment, peer assessment, and group dynamics provided by the system. Students receive guidance and information provided by the teacher through introductory sessions, tutorials, available resources, feedback, etc. Figure 3 shows a typical Available Resources screen for a course on Instructional Design.

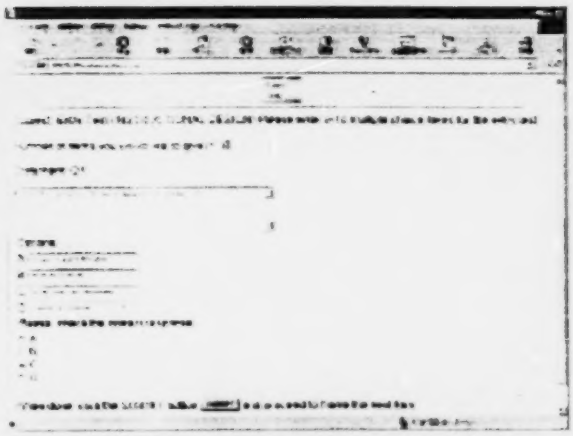

Figure 2. A screen in the teacher module for developing the entry test.

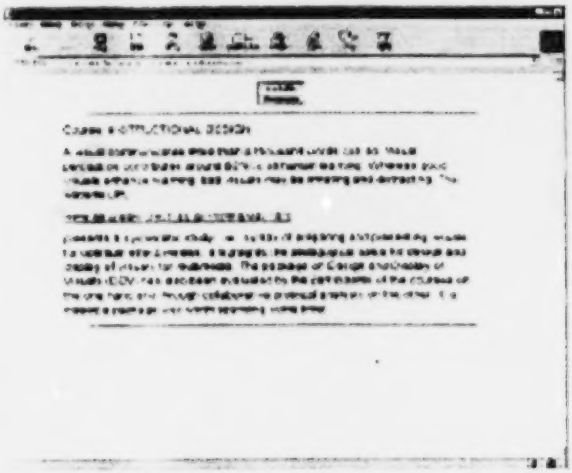

Figure 3. A resource for course on instructional design (Kumar, 1997).

Expected Outcomes

When it is implemented, the computer-based instructional system will have the following features:

- Faculty will be able to design and deliver PBL curriculum and will be able to play the role of facilitator in the problem solving process.
- Concept maps produced by the learners with the systems help will be the basic source of learner self-reflection and for assisting students/trainee teachers with understanding and misconceptions in order provide appropriate feedback.

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- Students/ trainee teachers will be able to develop, revise and maintain their own personal plans for learning, where the students control the scope and sequences of their learning.
- Students/trainee teachers will be able to collaborate on getting, organizing, presenting, and critiquing the information for problem solving.
- The information collected during problem-based learning will build up databases to be used by other students. In this way, the students/ trainee teachers will get multiple viewpoints on complex problems.

In brief, this system will help groups of people who work together, such as teachers and students, design and carry out learning goals which are meaningful to them.

Future Directions

We plan to implement the instructional system for the training of graduate students of educational technology in PBL. The present system will be especially useful for the inservice faculty who have little or no experience in a PBL curriculum. An instructional system that is content independent can be made content dependent and can be used for different subject matter areas. As we plan to implement the system through the World Wide Web, we plan to design a tool for asynchronous conferencing among a distributed learner population as a vehicle for training and implementation of PBL in a distributed learning environment. Then the system can be used for teacher education to provide the trainees a first hand experience of PBL when the teachers and the learners are physically at a distance from each other.

Sooner or later in the PBL curriculum, faculty from different disciplines will find themselves teaching together. If this is practiced then it will add another dimension to the present system as a computer-supported instructional system for team teaching for collaborative learning.

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The Education Network of Ontario: Implementation Stories

Terry Clarke
Education Network of Ontario

The initial stage of the Education Network of Ontario (ENO) was a UNIX-based, cross-platform, TCP/IP protocol distributed network application which provided bilingual (English and French) electronic mail, moderated conferencing (facilitated newsgroups), and database and Internet access across Ontario. It started with just 18 members in 1993 and has grown to register more than 50,000 teachers, administrators and trustees, nearly half of the 126,000 K-12 personnel of the province. The project has migrated to Web-based conferencing, electronic mail, document publishing and classroom projects. With this growth, we have learned a great deal about how educators use this suite of services. Presently, we are coaching over 4000 students engaged in teacher-devised classroom projects. Their personal and project work is published online for their families and communities to view.

Financial Support/Management

The Education Network of Ontario is financially supported by the Ontario Ministries of

Education and Training and Economic Development and Trade. The organization is housed at the Ontario Teachers' Federation, the professional organization of the 126,000 teachers of the province. The funding has grown from $200,000 to over $3,000,000 per year as more teachers, administrators and students use the services.

There is a very small central management staff of six with a trained field staff of approximately 30 who lead projects, moderate conferences and train colleagues in their home environments in either English or French. In the coming months, there will be a continuing emphasis on training teachers, administrators and students throughout the province. Moderated conferences, the private professional environment, and universal access continue to differentiate ENO's service from other Internet Service Providers or bulletin boards.

Technological Partnerships

The vast majority of the budget is allocated to infrastructure development and maintenance. Many of our more successful partnerships arise from investigation and implementation of new services and equipment. This allows ENO to do more technical development, implement better solutions, assess unique pieces of equipment, or acquire in-kind licenses or services.

For instance, AT&T Canada is working with ENO to create the most cost-efficient '800 service' which allows members to access ENO using long distance lines without enormous costs. In doing this, we are using software-based switching and blocking to bar local users from abusing 'free' long distance lines. We are progressing to using this service to build in automatic redundancy should one of our 'hubs' fail. We are also working with US Robotics and installing digital technology using innovative 'rack-mount' modems with built in routers and management tools.

We have signed an agreement and are working on Internet videoconferencing with White Pine, the company developing the videoconferencing software, CUSeeMe. A software and implementation solution by ENO is being compensated with a large licensing agreement. Because we are such a large system using the UNIX Operating System, SCO OSE (Open Server Enterprise) 5.0, we have been able to negotiate timely 'fixes' for problems that arise with new versions of the software.

Technical Issues

The network has a base structure of 34 'hubs,' each of which consists of a Pentium Pro server with (depending on the population served) 4 to 40 modems on a high-speed IP Wide Area Network which covers the province. The connecting links are 56 kilobits per second or higher to our backbone infrastructure which is connected to the Internet. The operating system is SCO OSE 5.0. The mail, conferencing, and web access all use off-the-shelf protocols and software to maintain the open systems standards and avoid ongoing software and upgrade fees. The major proprietary piece is the authentication server since few other networks are authenticating over 50,000 members to selective services depending on whether they are students

or adults, and the activities to which they are subscribed with transparent, province-wide access.

Users can dial from anywhere in the province free of charge and establish standard PPP connections enabling graphical display with a standard browser such as Netscape Navigator or Microsoft Internet Explorer. Members may also establish a text-based connection using Lynx if they do not have a graphics-capable machine or wish higher speed access to documents without graphics.

Of course, members can access the system from the Web site and be authenticated to the Intranet or private conferences through the authentication server. This allows the project to present services to a much larger number of members than would be possible through dial-up access alone.

Statistics and Effects

During a typical month, more than thirty percent of these teachers, administrators, trustees, technical and support staff, education faculty, their students, and Ministry of Education officials participate. The network logs over 4,000 participants a day and over 35,000 hours a month of connect time. A typical moderated conference, an Intranet newsgroup, generates several thousand searchable messages within a few weeks. To handle this volume of access and activity in such a large geographic area, we have modified the software from a simple bulletin board application to an integrated, Web-based suite of tools for telecommunications on a system of instantly updated servers throughout the province. However, the objectives remain those of a tightly knit education community: equality of access, pedagogic integrity and classroom-based action research.

Almost since the beginning of the project, women have participated at a level of 30% or higher. In fact the number of women in the group of those who access once a week or more is higher than that average. This reflects other projects which have investigated gender and participation in professional Internet activities.

Reasons for Success

A major factor in the system's success has been the freedom enjoyed by all participants and a supportive government grant structure. The ability of educators to use the facilities at any time of day, from both sophisticated and more modest machines, from school or from home, in either official language makes the process relevant for both classroom activities and lesson discussion and preparation.

Educators share a personalized environment of professional conferences selected from a list created by them and moderated and maintained by colleagues who receive a small honorarium or modest time relief. As well as the assistance and encouragement they receive from the online moderators, there is an active program of orientation and training about telecommunications from early navigation of electronic mail and the conferencing system to document retrieval from Internet sites and educational servers.

ENO's focus on creating and implementing creative classroom projects using connectivity among students and teachers around common activities continues to provide impetus to teacher participation. Personal student access codes have been a great success for the 4,000 students who have participated thus far. ENO has created a 'support' Web structure with traditional frequently asked questions and modem and browser settings. It is also embedding scripts with the ability to query the server for information and repair problems.

Activities

The major activity of the teachers continues to focus on the moderated conferences that are used to discuss and solve such global issues as local versus standardized evaluation, reporting to parents, community work/learn programs, and general subject-based or level-based curriculum issues. A second established use occurs whenever a new provincial license for software is purchased. A conference is opened in which the technical support team from the vendor can discuss issues of use and technical implementation with teachers throughout the province.

Smaller groups of teachers voluntarily initiate a series of professional activities such as writing primary school curriculum units themed on two-dimensional measurement with a central fictional character called 'Flat Stanley.' After the provincial collaboration, they then mount the curriculum units on personal home pages with pointers from ENO's home page. Those who create the material then update and maintain it.

Educators are creating a centralized resource of activities for teachers and administrators of northern schools who have no outside student recess for as long as six weeks in mid-winter. Others create a file of model parent letters and report cards for middle school students during a period of education reform. The network has a forum for school administrators in which teachers who wish to be administrators are mentored concerning effective career paths. Teachers, education faculty and students work on computer literacy curriculum units, plan professional development conferences, and hold meetings of subject-specific committee executives. One school of over 2000 students uses the system for its internal electronic mail, information distribution and meeting mechanism. Another district's school custodians are working on practical identification and warning about workplace issues and hazards.

Currently, we are developing on an online course about telecommunications in which templates for classroom activities are discussed, implemented in specific classrooms and improved for the system as a whole. Our largest project to date is an online environment to assist the National Marsville Program, a project based on intermediate-level students creating a living environment for the pioneer astronauts and settlers of Mars. Students are uploading their

air, water and food supply system drawings to their team's Web pages. They access mentors' comments from Spar Aerospace and the Canadian Space Agency. They communicate with one another to prepare for the final 'link-up' day. Using the online environment prior to the main event enhances classroom learning activities.

Summary

Because ENO's funding is limited, we continuously seek support from individual grants and strive to use resources outside of our small staff complement to accomplish tasks. For instance, senior secondary student journalists are engaged in reading the text of conferences to create and package 'stories' of the development of our WWW site. We are sharing points of high-speed access with other public sector agencies and ministries. Special educational projects purchase conference 'space' and moderation. We are instrumental in providing Ontario student access to the federal program, SchoolNet and look forward to greater integration with a more regionalized SchoolNet Web site in the future.

As we stabilize our network and work toward nearly universal direct dial-up and school access, we look forward to fulfilling our potential as a ubiquitous background tool for elementary and secondary education in Ontario. Our implementation focus concerns student projects and environment and our organizational focus is on financial sustainability. Our technical focus is aimed at increased access, speed and reliability through continuous experimentation with new modem, server and transmission equipment and technologies.

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An Effective Model for Creating Virtual Learning Technology Communities

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The "Support Service Crisis," termed such by the American Association of Higher Education, is a national crisis for services and support for the use of instructional and information technologies (IIT) in all educational settings. Although the larger goal is for all students, faculty, and staff to become self-sufficient with respect to using technology and be able to help each learn about technology, the immediate need is for support to develop a critical mass of technology and information-literate individuals who can function as core support for others.

Colleges and universities support themselves as well as their students and local industries by providing opportunities for their students to become technology assistants and training students to function in support roles. While such measures provide short term relief, long term support remains sporadic and provides uneven quality of service. State and local initiatives continue to grow in direct response to the need to provide for the development and implementation of online access for education institutions, faculty training, and PK-12 teacher training to include IIT.

In Wisconsin, for example, the state legislature, the University of Wisconsin System, and numerous business communities have combined resources to provide direct staff development for PK-16 educators, and have provided competitive funds to support regional and local projects to develop self-supporting staff development models. Similarly, K-12 institutions are coping by implementing their own staff development programs and relying on services provided by regional and local agencies. Many school districts have embraced the International Society for Technology in Education (ISTE) standards as guidelines for instructional technology staff development while at the same time many teacher education programs have incorporated them into preservice curriculum.

The need for support services is recognized as a continual and growing problem. Yet, the problem is not only one of meeting critical needs but is also a problem of making best use of available resources. Lack of coordination of efforts across agencies and poor communication between/among the various service providers results in duplication of efforts, under-use of technological resources, and fragmented progress toward larger goals. Fragmentation and duplication are too expensive to ignore in a time of limited resources.

The Virtual Learning Technology Community (VLTC) directly addresses the problems of fragmentation and duplication of efforts. Through a grant from the University of Wisconsin Extension PK-12 Initiative, we are establishing a regional consortium that ties together preservice teachers, K-12 educators, regional support staff, and University teacher educators. In particular, the VLTC provides communication networking, hardware, software, and training site resource sharing, and collaborative access to expertise among universities, K-12 schools, and support agencies (e.g., CESA, Cooperative Education Service Agency) in north central Wisconsin. It will become a self-sustaining community of learners who are constantly challenged by change, change that is driven in large part by technology.

The VLTC community members share a need for knowledge (an understanding of the nature and structure of using technology in teaching and strategies that work), skills (how to use the technology appropriately), and dispositions (a willingness to use and experiment with new technologies and pedagogies) surrounding the infusion and adoption of IIT. Further, the VLTC provides multiple opportunities to develop deep knowledge about regional strategies for the implementation and dissemination of the knowledge, skills and dispositions related to IIT. Increased awareness of emerging and effective strategies, resources, and expertise (both technological and pedagogical) will affect the K-12 environment as well as the university environment in synergistic ways. Developing new strategies for extending knowledge to others (thus increasing the overall base of knowledge and awareness of existing strategies) is central to the key notion of the VLTC; that is,

that a virtual community can share existing and dwindling resources while curtailing fragmentation and duplication.

Structure of the VLTC

The VLTC can be viewed as a network of conceptual, social, technological, and physical sites in the Chippewa Valley of Wisconsin. Each site can be viewed as a node in a neural or knowledge representation network. The nodes represent particular centers of expertise and knowledge such as university system centers and projects, cooperative educational service agencies (CESA), and K-12 districts. Each offers experience and expertise that can be shared with other nodes and offers opportunities for building new connections. Links among nodes are the communications pathways. Both the nodes and links need articulation and support if the community is to emerge as a living, growing model. Figure 1 below illustrates the conceptual structure of the VLTC.

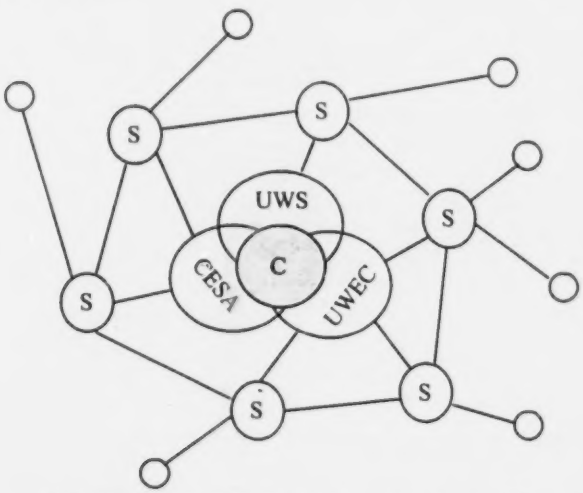

Figure 1. Conceptual structure of the VLTC.

The Coordinator (C) of the VLTC is responsible for establishing and maintaining the communication and relationships throughout the VLTC. The central nodes in the figure represent the initial core institutions: UW-Eau Claire (UWEC), UW-Stout (UWS) and CESA 11. The Center for Instructional Technology and Innovation, located at UW-Eau Claire, and formerly directed by Dr. Susan McIntyre, provides university faculty development using a virtual center and an infusion model. The Nakatani Center, at UW-Stout, is a real (vs. virtual) center that provides professional development for K-12 teachers using a training site model. CESA 11 provides on-site, in-school coordination and training for K-12 teachers. The second ring of "S" nodes represents K-12 school districts that already have existing staff development projects and relationships with one or more of the core institutions. These individual school buildings are linked to the core as instructional technology projects are shared between/among the VLTC community membership. The small circles represent future projects that will emerge as the VLTC community grows. Each line represents an existing or emerging communication link.

Establishing the VLTC

Developing the VLTC is a three-year process. Our goal is to connect and support ongoing "pockets of excellence" by enhancing their ability to grow and share expertise. Then, we will gradually add new staff development projects and sites that draw on the pockets of excellence to extend everyone's existing knowledge and skill base. The process of establishing the VLTC is described in detail below.

Phase I: Establishing the Virtual Learning Technologies Community

The VLTC project requires a coordinator with time and resources to foster communication among core institutions, find suitable training sites and key personnel for the VLTC team, establish a communications process among participants, coordinate identification of model learning technology projects among participating institutions, and coordinate the selection of projects being supported. Key teachers at the K-12 and university levels, student interns from the university and some K-12 students will serve as the advisory council to the VLTC Coordinator. This advisory council will meet at least two times per year over the three-year period of the project to review the activities of the VLTC relative to the mission and vision, examine emerging needs, and develop ideas for meeting new needs and providing for dissemination of information regarding the VLTC activities.

Phase II: Establishing Links between the VLTC and Regional Institutions

The emphasis in phase II will be to build links between the VLTC and area institutions. By identifying model projects in PK-12 institutions, CESA, and UW institutions, establishing support, training, and materials needed to enhance the model projects, and finding collaborative mechanisms to meet identified needs, the VLTC will effectively generate a regional network. Support for new or extended projects will be enhanced through opportunities for advanced graduate study by VLTC teachers. UW system institutions will provide additional support for VLTC projects by developing cadres of university students in teacher education programs interested in working in VLTC schools. The participating university students will supply some technical expertise, learn new ways of integrating technology into teaching, and assist VLTC teachers as they develop new projects. To increase the quality and timeliness of the communication between/among the advisory committee and the VLTC participants, a telecommunications network using a client system such as the First Class network software will be established.

Phase III: Strengthening Links among Regional PK-12 Schools

Phase III will extend and strengthen the social context supporting the risks and growth associated with changing teaching and learning paradigms. Through a variety of mechanisms, VLTC participants will share their developing knowledge of current regional projects, establish communications, and publicize ongoing efforts. We will also conduct mini-conferences in which VLTC members spend focused time working together to extend their existing projects. Additional opportunities for sharing new knowledge include the Northwest Education Association annual meeting, the annual Technology Fair sponsored by CESA 10, professional conferences such as Wisconsin Council of Teachers of English, Wisconsin Society of Science Teachers, Wisconsin Elementary and Middle Science Teachers, and Wisconsin Math Council. These avenues are of particular importance because they encourage participants to think about technology as a tool for learning subject matter rather than just learning about technology.

Phase IV: Supporting New Projects Impacting Students in VLTC Schools

The VLTC will coordinate activities in which participants identify opportunities to continue to work together to develop new and spin-off projects that expand the impact on learners (e.g., parents of students in the K-12 schools, faculty instructors for student teachers and graduate students in the K-12 schools). The VLTC will provide communications links between the participants for sharing of ongoing projects, find ways to meet new training needs, and support efforts to generate new resources.

Evaluating the Success of the VLTC

Key outcomes of the VLTC include: (a) the development of a self-sustaining community focused on state of the art use of instructional and information technologies; (b) increasing student and teacher ability to make effective and efficient use of technology; (c) increasing the overall quality of student learning; and (d) increased communication, increased relationships between/among the constituents of the VLTC and better access to new and existing initiatives for the entire set of participants.

Formative evaluation will be accomplished through questions posted to the *electronic network* and through *small-group interviews*. *Artifacts* drawn from school projects will provide further evidence of teachers' readiness to implement technology-rich curriculum and teaching strategies. Student growth will be monitored in a similar fashion. We will administer a modified version of the *technology survey* to track growth in students' basic knowledge and skills. Since a key element of learning is the ability to locate, evaluate, and effectively use information, we will gather *samples of student work* that require demonstration of those abilities and support the artifacts with participating *teachers' evaluations of student growth*. Further evidence will be gathered by conducting *student interviews* at participating schools. Finally, the advisory team will meet at least two times per year over the three-year period of the project to review the activities of the VLTC relative to the mission and vision, and examine emerging needs.

Evaluating the outcomes of the VLTC on teachers' and students' knowledge and learning skills is an essential process guiding the evolution of the VLTC. Central to the mission of UW-Eau Claire is faculty/student research and collaborative activities. Therefore, preservice teachers (undergraduate students) will work directly with VLTC faculty and staff in carrying out assessment activities. In particular, the VLTC faculty, staff and students will track changes in teachers' perceptions of their own knowledge and skills using a pre-post *survey* of teacher's technologies skills and readiness to implement ISTE recommendations. The survey is currently in use in the School of Education at UW-Eau Claire.

Summary

Efforts such as the VLTC are essential if support for IIT is to grow. Understanding the processes of developing models that make creative and efficient use of resources provides valuable insights needed for extending the VLTC approach to other arenas. The VLTC is replicable in most environments because it uses existing technology and human resources to address contextualized needs. It doesn't require technology experts, or large capital expenses. It is adaptable because it draws on local expertise and shares ideas and knowledge within a learning community and therefore provides participants with multiple entry points, regardless of grade levels and/or levels of expertise.

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Using Telecommunity to Develop a K-16 Approach to Education Technology Adoption

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In the state of Ohio, three current state technology initiatives, SchoolNet, SchoolNet Plus, and Telecommunity have been funded. Combined, these three projects have dramatic implications for each other. The goal of SchoolNet is to provide network capacity for every K-12 classroom. The goal of SchoolNet Plus is to provide one computer workstation for every five students in grades K-4 while the goal of Ohio's Telecommunity initiative is to increase collaboration among schools and service providers to enrich the public school curriculum. The three programs represent a $700,000,000 commitment by the state and service providers to infuse technology into K-12 education and set the stage for cultural transformation of teaching and learning in Ohio. Moreover, if these initiatives are to enjoy widespread adoption throughout the state, it is critical that schools of education and K-12 schools collaborate to develop a K-16 approach to pre- and inservice teacher education in the area of educational technology. The Technology in Education Adoption Model (TEAM) recognizes the importance of this approach to professional development and this paper describes how one successful Ohio SchoolNet prototype, Partners In Learning, located in Oxford, Ohio, has developed a K-16 telecommunity to encourage the adoption of educational technology.

Restructured Learning

In 1990, *Partners in Learning* was organized by Dr. Douglas Brooks of Miami University, as a community-wide collaborative leadership team that included the Talawanda Local School District, Tri-Village Local School District, Miami University, the Oxford Chamber of Commerce, and communications companies, Warner Cable and GTE. The vision of *Partners in Learning* embraces the national goals of education, Ohio's vision for school renewal, and advances a "break-the-mold system" for high performance teaching and learning in extended learning communities. The goal has been to design and implement a prototype of a "near and distanced learning community" that would guide Ohio schools, communities, and universities into the 21st century. This prototype learning community features the application of integrated technologies to: (1) enhance learning systems design; (2) develop an extended learning community; and (3) enable full human resource development through life-long learning.

Partners In Learning/SchoolNet has been operational for 18 months and is now the first and best example in Ohio of how a telecommunity can stimulate and support a K-16 approach to educational technology adoption. Two hundred-eighty teachers and administrators in 15 buildings across two school districts and Miami University are in the early developmental stages of "near" and "distanced learning." Project teachers have "near distance" learning capacity using FirstClass telecommunications software as well as Internet access. Data collected during the first 18 months of use has provided critical insight on the natural maturity of near and distanced learning in classrooms. This data has been collected using questionnaires, journals, online surveys, and measures of use information retained by the network system software.

Results of Telecommunity Development

Infrastructure

The project infrastructure has performed with great reliability. Teachers and administrators have reported that reliable SchoolNet system operation has stimulated teacher access and use. Two category-five wires and two coaxial cables were installed in each classroom close to the teacher's workstation, conveniently located for easy access.

Access

The number and frequency of teacher and administrator logons have grown steadily over the 18 months of the project. The goal of the access phase of the project was to reduce to a minimum the number of mouse clicks and keystrokes necessary to access FirstClass telecommunications software or the Internet. Launchers were configured for all teachers' computer desktops to enable quick and easy access to telecommunications and other software. In

classrooms where the Launcher was not used, teacher use of telecommunications tended to decrease until the Launcher was reinstalled or activated. Morning logons to FirstClass were also stimulated by the presence of building and district news bulletins posted to its conferences by administrators and building secretaries. In addition, teachers who reported difficulty accessing the FirstClass telecommunications server were (and are) immediately provided with mentoring from another teacher and/or help from building technology support personnel which includes high school students organized into a "Tech Squad."

Professional Development

The professional development plan has been guided by a "Teacher Leader model" that emphasizes voluntary, personalized, and developmentally sensitive training and curriculum development. Teachers are encouraged to participate, but not required to do so. Two consecutive two-week summer "Playshops" have attracted over 60% of the project's 280 teachers who participated in team building and online simulations conducted over the FirstClass telecommunications network. High school students were hired to provide technical support during the summer "Playshops" and remain part of the "Tech Squad" during the academic year. The Tech Squad sets up and makes minor repairs on computers, solves problems through a "Help Desk" on FirstClass, documents teacher competence gains, and helps identify emerging technology needs. In fact, this systemic use of students to provide technical support has proven to be critical to the success of the project. The results of this past summer's telecommunity training have been spontaneous online mentoring, resource sharing, and content access from Miami University.

Telecommunity has also permitted dramatic advances in preservice teacher development. University and preservice teachers now have telecommunity support which has changed the structure of university mentoring during student teaching and dramatically extended the learning community available to preservice teachers. For example, in the computer module of EDT 343, Media and Technology For Teaching, all students are required to use *Conferencing on the Web*(COW) to ask SchoolNet teachers about teaching strategies related to using technology. Since COW is Web-based, students have had online conversations with teachers as far away as northwest Ohio, providing students with resources which otherwise would not be available to them. Whenever possible, student teachers are placed in technology-rich SchoolNet classrooms with the objective of further developing their ability to integrate technology into curriculum and instruction, skills which were introduced to them in the computer module of EDT 343. Using SchoolNet resources, telecommunities have developed between university supervisors, mentor teachers, and student teachers to enhance communications between all parties and advance student teachers' learning experiences and opportunities. Student teachers and their supervisors are also given regular opportunities to develop their teaching with technology skills on a per-request basis and to develop a Web presence by learning HTML and Web site design skills. As a result, students have learned new technologies like HyperStudio and developed personal home pages, online professional portfolios, and Web pages to support the respective classes they teach.

Curriculum Development

Talawanda City Schools and Tri-Village Local Schools are also collaborating districts in Ohio's *Schools On The Move* project. The goal of this project is to design a technology-supported curriculum that improves fourth and eighth grade proficiency test scores. These two districts, along with Miami University, were selected because their intact SchoolNet infrastructure could produce information on the impact of telecommunity-supported curriculum development. Unlike other participating schools, a Web site (at http://www2.eap.muohio.edu/SoM/) was developed by Dr. Kevin Maney of Miami University for constructing *Lesson Labs* that can be authored, edited, and shared across districts and teachers. Results to date suggest that more frequent, timely, and cost effective communications are occurring between project participants than in other areas of the state where the SchoolNet infrastructure has not been installed.

Summer SchoolNet "Playshops" have also been designed to provide authentic opportunities to improve current instructional activities and to extend curriculum design into more advanced technology-rich activities. Consistent with ACOT research (Sandholtz, Ringstaff, & Dwyer, 1997), teachers have sought first to improve their current practices and then pursue more advanced applications and activities that employ available technologies. Moreover, a curriculum bank developed in the "Playshops" is stored online and teachers have reported accessing this resource for ideas on how to integrate technology into their instruction. Perhaps most exciting is that these same teachers can use the "Chat" or simple e-mail features of FirstClass to contact the author of the curriculum idea for clarification and suggestions. In contrast, the chance of a classroom teacher contacting the author of a textbook is almost nonexistent. As teachers use these SchoolNet-based resources and engage in professional development opportunities to enhance their teaching with technology skills, they also become better able to mentor preservice teachers, both in person and online, who are learning to do the same in university environments. This is the component of teacher education programs that is usually missing, but which is critical to training preservice teachers to use technology as tools for learning (OTA, 1995).

Transformative Realities

Transformative outcomes in the *Partners in Learning* SchoolNet project have proven to be developmental. In both Talawanda and Tri-Village Schools, the intermediate level building emerged as the district leader in the full application of telecommunity and the following developmental stages have been identified in the process.

Installation and Access Equity Stage

This stage is characterized by computer availability and total faculty access to the FirstClass telecommunications server via their computer desktops. Teacher Leaders were predictably the first group to be interested and motivated to master access skills whereas non-users elected not to attend professional development opportunities or to contact building technical support to help them develop the skills needed (four key strokes) to access the network. The main reason cited by non-users for not using FirstClass as a communications tool was that not all of the district's personnel used their computers. System-wide strategies to move teachers and administrators past this stage included checking for connectivity problems, buying a full complement of computers for all teachers in all buildings, standardizing and minimizing the routine needed to access FirstClass, problem-solving with building-level teachers and student technical support, and checks of system logons to identify non-adopters.

Play and Interpersonal Use Stage

This stage is characterized by teachers and administrators who were comfortable with each other exchanging non-substantive e-mail and using the FirstClass "Chat" feature to converse online about non-substantive matters. Others reported using Internet e-mail to contact relatives, especially children at college. In contrast, non-users tended not to play even when they understood that they could access the system and were seemingly cognizant that the network had "Play Potential." The common reason cited for not "Playing" was that they did not have time to to do so. System-wide strategies to move teachers and administrators past this stage included invitations to work with trusted, but more advanced, colleagues after school or on weekends, to take summer Playshops, or have a Tech Squad student privately mentor them.

Building and District Information Stage

This stage is characterized by the building administrator endorsing and using telecommunity as a management system. Adopter administrators actively modeled the use of the network and invited office staff and Teacher Leaders to imagine and implement FirstClass as a building communication and management tool. In contrast, non-user administrators did not actively model the system and they tended to rely on conventional communication systems like announcements, faculty meetings, newsletters, daily bulletins, and classroom visits. While FirstClass conference environments emerged in the developmentally advanced buildings, the conference environment and file accumulation within conferences remained minimal or nonexistent in the buildings of non-adopting administrators. System-wide strategies to move administrators and teachers past this stage included creating online building conferences, suggesting to office staff and administrators how FirstClass telecommunications software could facilitate office tasks, training individual secretaries on ClarisWorks to create daily bulletins and newsletters, and regularly reporting on advanced applications in other buildings.

Individual and Team Instructional Stage

This stage is characterized by individual teachers or small teams of teachers at the same grade level or content area combining energies and technology skills to improve or develop instructional activities. Non-user teachers chose not to team with adopters, elected not to participate in immersion or individual training sessions, and were not drawn to self-directed, discovery, or simulation-type professional development sessions. The main system-wide strategy used to move administrators and teachers past this stage was the two summer "Playshops" organized so teachers could work in teams within their own buildings and classrooms. Data from teachers' daily journals and an exit survey suggested that the design of the Playshops complemented self-directed and discovery learning styles and created advanced Teacher Leaders for colleague mentoring in technology use. Teachers who did not enjoy these approaches to learning received whole group, professionally led, hands-on skill training that targeted specific computer applications. The combination of these two approaches appears to have significantly advanced the overall skills of the project's teachers and consequently increased their capacity to serve as resources for preservice and student teachers.

Projects and Initiatives Management Stage

This stage is characterized by the use of SchoolNet resources and the conference feature of FirstClass to manage projects, grants, and initiatives that emerged as the school year unfolded. Grants managed in this fashion appeared to flourish whereas non-user teachers and administrators who continued to rely on frequent committee meetings showed limited productivity. Moreover, while FirstClass conference folders were often created for projects, if the project director did not utilize the network infrastructure and software features, the project participants were not inclined to do so either. System-wide strategies to move administrators and teachers past this stage included e-mail reminders on the effectiveness of FirstClass, meetings with project directors to encourage its adoption, and designing functional project desktops on FirstClass. These efforts, however, were mostly to no avail.

Interorganizational Communications Stage

This stage is characterized by communications between pairs of teachers or administrators between the Talawanda and Tri-Village school districts. Adopting building administrators and teachers have been capable of using the FirstClass network at this level but it remains the most undeveloped of the stages with the fewest examples of productive outcomes. One reason for this is that many teachers and administrators were very sensitive to online remarks made early in the partnership. While the connection between with Miami University and the two school districts is maturing at an advanced rate, interdistrict collaboration is almost nonexistent to date. Speculation that face-to-face contact is a prerequisite for extended network collaboration remains supported.

Conclusion

The *Partners In Learning*/SchoolNet Prototype in the Talawanda City Schools, Tri-Village Local Schools, and Miami University is positioned to advance and offer developmental insight on teacher and administrator network, telecommunity, and curriculum development as well as education technology adoption. Outcomes to date suggest that near and distanced telecommunities, properly installed and professionally developed, can have a transformative impact on the culture of teaching and learning and serve as a critical component of a K-16 approach to the adoption of education technology.

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NETWORKED LEARNING COMMUNITIES IN TEACHER EDUCATION

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Faculties in schools of education are challenged to prepare educators for a changing world. The world of learning is changing and there are numerous possible scenarios for the future of education. In Canada, a growing number of educators are proactive in the face of a networked world. SchoolNet (http://www.schoolnet.ca) and its educational partners have been instrumental in articulating the possibilities that lie ahead. Learning and learning systems may also move in a number of possible directions.

SchoolNet's Vision of learners (SchoolNet, 1996) presents key aspects of the preferred future of education and this vision can be assessed in terms of some of the following major alternatives:

Business as Usual. We continue going as we are, relying on our existing assumptions, structures and labour-intensive ways of teaching and learning. Attempts continue to integrate technology into existing structures. Resources are limited and in many places decline, affecting learning quality and public confidence. Competition among schools and school systems intensifies. Is this approach serving individuals and society well at the present time? Can we provide quality learning services with the resources available? Are we missing opportunities to make creative use of the new technologies?

The Funnel. The range of employment opportunities narrows as technology and global competitiveness limit the job market to low-level service skills needing little education and high-level technical and managerial skills based on post-secondary certification. For most of the population, a rewarding job is a scarce resource with few winners and many losers. What happens to the link between learning and career? What kind of learning is needed for those outside the job funnel? Can learning enlarge the funnel? Do we need new definitions of work and job?

Competing Systems. There is growing political conflict and economic competition for clients and funding; between the present education establishment and the virtual learning system of communications and information technologies in which teachers and institutions are of minor importance. Is such a conflict inevitable, built into the nature of competing philosophies? Is it helpful or dangerous?

In contrast, our preferred vision, as expressed in SchoolNet's Vision of learners, is one in which the need for all to learn is embraced and translated into a converging, vigorous action-research program. In this program, the new requirements for knowledge of technology is a key driver and a key enabler.

Cultivating the Need to Learn

The individual's need to learn must be met in considerate and meaningful ways. The necessity to improve our pedagogies is there, and part of the pressure is coming from young learners who are "growing up digital"(Tapscott, 1997). Moreover, too many children leave high school with a lesser desire to learn than when they entered. This is unacceptable for any nation wanting to evolve as a democracy, be part of the new global economy, and have its quality of life benefit from technological developments.

Higher expectations for all is also a reality in the realm of education worldwide (see UNESCO, 1996; OECD, 1997). Countries which foresee an economy where half of all new jobs created will require a university degree, must move away from associating high school schooling with social selection. Though it is voiced that without a high school diploma, individuals' futures will be greatly reduced, educational systems are slow to transform themselves in such ways as to offer more engaging learning activities and provide more flexible learning. As educational systems decentralize — a major worldwide trend — there are educators and communities who understand that the education of all children (and adolescents) is now both a moral and an economic imperative. However, classroom interaction is very timidly looked at as the essential core that could make the difference if adequately transformed. Our main research assumption, as we foster networked communities in our work as educators of educators, is that it is the interaction between the learner and knowledge, scaffolded by the teacher, that is the most critical one.

School and classroom organizations have been modeled to serve an industrial era that now belongs to the past. The hidden curriculum has been to prepare obedient, conformist, and competitive individuals, and classroom interaction has successfully been directed to these ends. Today's technology, educational research and social expectations now call, and support, the move of educators and communities whose purpose for schooling children is

to foster their intellectual capacities and creativity in many diverse ways and at higher levels, and who are willing to monitor, and temper, their own need for control to the benefit of learners' acquisition of autonomy and capacity for collaboration.

The New Requirements for Knowledge of Technology in Education: A Key Driver and a Key Enabler

In the context of our schools, the need for professional development is realized by teachers most directly in relation to information and communication technologies. The goal of integrating these technologies is at the same time creating a requirement for new knowledge, as well as creating new opportunities for cultivating knowledge. More and more educators understand that current requirements for technology in schools are markedly distinct from earlier attempts to import computers into the classroom by fostering specialists and leaders who form a minority of highly knowledgeable individuals. Today, the achievement of a better distribution of the knowledge is a growing imperative. One identified means to achieve this coverage is the initiation of learning communities formed mainly (but not exclusively) of teachers and student-teachers. This need for a more collectively oriented approach to knowledge is illustrated in Figure 1 on the vertical axis. This dimension complements the "Type of Participant" dimension in Mergendoller, Jonhston, Rockman, and Willis, (1994).

Figure 1 also illustrates another dimension that characterizes the new requirement for knowledge of technology: the need to use technology within a transformative vision of learning, to support with technology the new learning that could barely take place before, for example, the advent of networked computers. This tension between reproduction and transformation, illustrated in Figure 1, on the horizontal axis, corresponds to the contrast between a "focus within," to adjust the current system, and a "leap out" from the boundaries of our existing systems (Banathy, 1994).

An important aspect of the conversations we are having within our professional development activities is to qualify the major components represented in Figure 1:

- Ownership of knowledge: in what ways can we characterize the relationship to knowledge in our different settings; what does a collective ownership mean with regard to knowledge of technology; through what processes can experts in the school setting (including students) become better able to share their knowledge?
- Vision of learning and technology: what are the characteristics of profound uses of technology; what is exemplary use of technology in support of learning; what types of transformations do we expect to see as a result of exemplary use of technology?
- How can we characterize different communities in terms of the four quadrants in the figure (A, B, C, and D); and how can we characterize professional development in terms of movements across the quadrants (e.g., from A to C, and from C to D)?

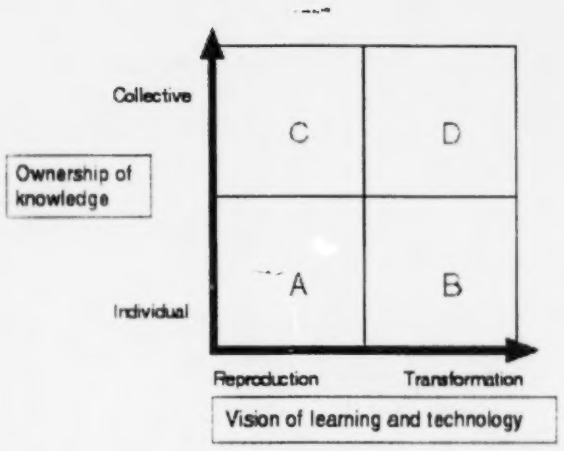

Figure 1. Dimensions of TeleLearning Professional Development.

Schools Of Education's Response

In response to the growing needs for learning and the changing worlds of education, our schools of education are working on a converging, vigorous action-research program, based around the TeleLearning Professional Development School (TL•PDS). We present three key goals of our TL•PDS (with associated practices and findings for each goal):

- making the discourse on learning and the knowledge about learning more public to sustain a knowledge-based society;
- developing new knowledge of how telelearning technologies can support sustainable communities of learners;
- extending opportunities for the professional development of educators through Web-extended institutes and practica.

To act responsibly in the face of the uncertainties mentioned above means asking ourselves what kind of learning environments should be designed for children and adults to learn and grow. As educators of educators, we know, for instance, that we need to immerse future educators in powerful learning experiences that lead to the development of generative, adaptive, and robust knowledge. These learning experiences need to be embedded in rich, authentic contexts such as intensive practica, face-to-face encounters and seminars. The cultivation of knowledge is best achieved through a process of conversations and reflection.

One promising response from schools of education in recent years has been the articulation of closer collaboration between universities and schools through "professional development schools" (PDSs). The PDS model, as

implemented at numerous sites, has been well formulated in the recent Draft Standards of the National Council for the Accreditation of Teacher Education (NCATE, 1997a). We are expanding the PDS model into the TeleLearning PDS described below.

The TL•PDS

The TeleLearning Professional Development School is a multi-site network of Faculties of Education (Laval, McGill, Oise/UT, and University of British Columbia) with their connected associated schools. It is a research activity of the TeleLearning Network of Centres of Excellence, funded in September 1995 through the Social Science Research Council of Canada. As faculty members of McGill University and Laval University, we are contributing to building new models of professional development and teacher education that are required today to address the new needs for technology knowledge and use of technology of practicing and graduating school teachers.

Establishing communities of learners around the teaching professional and student-teachersupported by networked computers is one major component of the new model we are designing. As we implement this model, within each learning community, high school learners, student-teachers, school-based and university-based teachers are interacting in increasingly differentiated ways. As in other communities of learners (Brown, 1997), we base our design on agency, reflection, collaboration, and culture.

Within our research network, the design of such communities is seen as critical. At each setting, this community, based in a school or group of schools, sharing a vision of school learning and teaching, establishes for itself goals as well as instruments to acquire and share the knowledge required for the achievement of their goals. In this context, we are facing a larger and more and more differentiated number of learners (the entire school staff, the parents, the students, etc.), and we need to consider effective learning mechanisms to handle this demand. We have to establish a community of learners that will be able, to the largest extent possible, to handle its own learning needs and to build capacity for the school to adapt and grow.

The TL•PDS is a construct anchored in two major realities: the physical PDS (professional development schools where there is substantial use of technology for teaching and learning) and the virtual PDW (professional development webs constructed at each site, using various telelearning tools (such as the WWW and online discussion forums), linked to one another, and which support and reflect the activities occurring in the PDSs). Two official languages are spoken in the TL•PDS, English and French.

To establish networked learning communities in teacher education that help shape emerging practices is a work of design fostered and documented through our research activities. It is, in the words of Banathy (1994), a "future-creating disciplined inquiry."

The Telelearning Professional Development Web

The task of helping student-teachers learn new pedagogies for instructional purposes in a rapidly changing social context is supported by Virtual U. Built on ten years of research (Harasim, 1997), Virtual U is a Web site with authorized access, a powerful conferencing system, internal search engine, learner workbenches, and more. This telelearning environment currently supports teachers' collaborative reflective practice (pre-active, interactive, and post-active phases) and knowledge-building, thus addressing complex questions and perplexing dilemmas inherent in daily practice. Online discussions about curriculum and pedagogy (PDW) merge with face-to-face conversations (PDS) to contribute to the learning experience of the student-teachers who participate in the program.

The anonymity of the student-teachers, teachers, and teacher educators is protected, and the sites opened to others who want to explore the benefits, on a voluntary basis, of the resources of this learning place. Ways of fostering and managing these virtual communities of practice are progressively uncovered.

Making Public the Discourse and Knowledge of Learning

A first important objective of our TL•PDS is to make the discourse on learning and the knowledge about learning more public. The need for greater awareness of learning, and of ways of knowing and talking about learning, is another requirement of a sustainable knowledge-based society. The American Psychological Association's Learner-centered psychological principles (1995) have been found instrumental in this respect. In order to build our knowledge society, we need to allow more people to talk in more sophisticated ways about learning.

The TL•PDS uses telelearning tools in order to achieve this objective. Local Web sites are found informative by student-teachers and educators. Student-teachers, cooperating teachers, and teacher educators participate in online discussion forums. The discourse that is created in this context is useful in achieving resolution on key challenges that educators face in their practice. The discourse also has interesting additional properties: because it is online and written, there is the creation of a social text that is inspectable. This text, in turn, becomes the object of sharing and shaping of knowledge about learning.

To illustrate, there are, this semester, at Laval University, over 15 discussion forums related to four student-teacher cohorts (15 students per cohort, 3 cooperative teachers, and 3 university-based teachers). Three student-teachers are involved dailyin a high school which is implementing a program, PROTIC (Programme PRO

Technologies de l'Information et des Communications), now involving 62 children, all receiving laptop computers, which foster project-based learning. Twelve other student-teachers visit the school once a week. Others are "virtually" connected through either their discussion forums and/or the Web site.

Topics and Learning Scenarios. In this PDW, the education of reflective teachers for elementary and secondary schools, ones who will understand the use of telelearning technologies for high-level learning tasks is the problem at hand. Subtasks are identified, and gravitate around the three moments of the teaching act (pre-action, inter-action, and post-action). Planning, implementation, and evaluation tasks have their own components, and these are more often than not left to the initiative of each individual or team.

The discussions have centered around the following scenarios and learning issues:

Participant observation. Student-teachers 1) observe classroom interaction and/or participate in the ongoing learning activity; 2) present a descriptive statement and comments on a particular element of the observed educational situation within a VGroup (Virtual U); 3) construct, later in the semester, reflective statements using one another's first-hand journal excerpts.

Deliberative role learning. Student-teachers acquire knowledge in changing social expectations and explore the evolving roles of teachers and learners in telelearning environments. As their personal values, learning styles and habits are at times confronted by newly emerging pedagogical practices, some value conflict resolution must be found, and face-to-face meetings are most instrumental in this respect. Online discussions contribute to the uncovering of new possibilities for learning and teaching.

Professional development planning. Student-teachers are using a VGroup to plan for future professional development that will unfold during their induction years in the teaching profession. Plans include ways to learn to integrate telelearning technologies, and to stay connected to the professional development Web.

Collaborative reflective practice. Teachers share their understanding of specific learning situations, and find ways to improve future action. At first, patterns of connection reflect local activities and research preoccupations. As common understanding and opportunities for collaboration grow, more cooperation, coordination, and integration occur. These patterns parallel Banathy's four phases (1991).

Knowing How to Support Sustainable Communities of Learners

The TL•PDS is developing new knowledge of how telelearning technologies can support sustainable communities of learners. Knowledge grows out of the interactions taking place in this virtual community, and of reflective practice. Because each site is developing its own Web site (Tact, Csile, Studio A, McGill TK), each offers a unique and context-based perspective on the integration of ICTs (Information and Communication Technologies) in learning environments. The building of interactive capacities within and across sitesis seen as highly relevant by the teacher educators and researchers. They aim at assisting preservice and inservice teachers while gaining knowledge and skills of a practical or intellectual nature which they are called upon to master, in order to accomplish the tasks and functions expected of them now or in the not too distant future.

Our willingness to use telelearning technologies in such ways as to contribute to the creation of functional and collaborative communities of practice has led to the following practices:

- at the process level, patterns of connection (between high school learners, student-teachers, teachers, and teacher educators) were examined, using principles of discourse analysis, and used to guide further steps in the design of the TL•PDS;
- •• at the content level, bi-polar themes have been identified, including public-private, school-work learning and tradition-innovation. Student-teachers' concerns for classroom management issues are crossed by these different tensions.

Preliminary examination of our data reveals important patterns of conceptual change triggered by participating in a networked community: changes concerning the conception of the learner, of the teacher, and of the modes of interacting with knowledge objects. Another important finding concerns the high inter-dependency between these changes: certain re-conceptualizations of the teacher's work are possible only from a re-conceptualization of the role of the learner, and of the relationships between the learner and various knowledge objects. For example, building groups of active learners supported by potent technologies create powerful opportunities for teachers to participate in professional communities.

Our experiences also inform us of the important role of the online discussion facilitator. One major aspect of this role is to help participants negotiate their transitions between physical and virtual worlds. In order to maximize the level and quality of participation, it now seems useful to use "transitional objects:" symbolic objects that can be present or even produced in face-to-face situations and then digitized, with opportunities for further manipulation and sharing in the virtual group. For example, the concept maps produced in a seminar meeting using physical transparencies and markers, discussed during the meeting, can be posted on the seminar Web space for further reference. The concept map then becomes a symbolic object that helps participants relate their work from the physical onto the virtual.

To facilitate participation in virtual groups, two other important conditions have been identified: the clarity and centrality of expectations to participate, and the specification of complementary roles and responsibilities. For teachers and students to participate in online discussions, these discussions must be set as an integral part of meaningful learning activities. It must be clear that all are expected to participate, and that participation is fully valued. Situations where the online discussion is an add-on do not generate productive work. Similarly, the complementary roles and responsibilities allow individuals to focus on a certain layer of conversation, while keeping the whole discussion in mind. By including responsibilities to report from other discussions, different sub-groups can maintain a coherent picture of a conversation that would not be manageable otherwise (for instance, in the case of forums reaching 600 kilobytes over a four-week period).

Resources and Assistance. The TACT Web site (with its electronic materials and links to materials on other Web sites), collaborative spaces such as V-Groups, Web-CSILE databases, CD-ROMs, videotapes, conceptual maps and representations provide computer-supported collaborative learning environments to student-teachers and teachers. E-mail and the exchange of files remain basic ways of communication, but our collaboration is increasingly supported by V-Groups (Virtual U). Once a statement or a question has been written, students are eager for a response. Ways of managing the increased expectations for social interaction must be found.

Simulations as such are not used per se, but evocative examples are. More experienced participants help less experienced ones. Sometimes, a student has learned something only a few months, weeks, hours, or minutes earlier, and is asked to guide a newcomer in a particular task. Coaching on the part of the instructor is key, including technical assistance at times. It must be stressed that the use of telelearning technologies acts as a catalyst for the transformation of the role of the traditional teacher. Modeling is key, and entails the roles of teacher facilitator, coach, mentor, guide, mediator, project manager, and director of learning (for additional information on teacher beliefs and practices with these technologies see: http://www.education.mcgill.ca/fedwww/cils/Telelearning/Telelearn.html

The sharing and shaping of experiences in ways facilitated by the increased information, communication, and collaboration powers of new technologies are becoming more and more obvious. Collaborative teaching is in sight. The main focus is on the knowledge teachers use in the process of implementing information and communication technologies in their teaching.

Web-Extended Professional Development for Educators

The third main goal of the TL•PDS is to provide extended professional development opportunities to educators (including practicing teachers, student-teachers, and teacher educators) through establishing regular learning activities, Web-extended institutes and practica.

Our design of TL•PDS, and the discussions taking place within and between each site, reveals the challenge of sustainability in establishing learning communities in teacher education. We treat this challenge in terms of requirements to embed activities that survive single teacher-development events and that will become part of the school and/or university ethos. Examples of such activities are e-mail discussions, team work on curriculum innovation with technology, lunch-time project sharing, and various celebrations.

Another example of the ways in which it is possible to provide extended professional development for educators is our current design of TeleLearning Institutes. The first of these Institutes is planned to occur with the McGill Faculty of Education in August 1998. The essential components of the Institute are the objectives, the theme, and the process we are designing to ensure that the Institute is coherent with established long-term relationships. The objectives of the Institute are to allow participants to:

- learn to use ICT in support of student-learning;
- create resources that will be useful in teaching and learning current curricula;
- plan the school Web site and prepare continuous work to maintain it;
- establish and deepen collaborative working and learning relationships with colleagues both online and face-to-face;
- discover ways of using technology to collect, interpret, and share portfolios of student learning.

The theme of the Institute is "The Web site as a strategic project for the school." Around this theme, participants will work on the establishment of learning resources and student-centered projects on the school Web. In order to ensure that the Institute is coherent with established and long-term relationships, we are inviting teams of teachers and administrators from our PDSs to join teams of student-teachers and faculty members. Members of teams at the Institute will work together to share information and to connect their resources.

School-based teams of teachers (possibly with school administrators) will be working during the Institute on the initial design of their school home page, or on improving the existing design. They will identify specific accountability measures to evaluate the success of their Web design (for example, in terms of the capacity of students to achieve higher learning goals). Each school team will be matched with a team from the Faculty of Education composed of one

faculty member and two to three student-teachers who will be doing their practica at the school. The Faculty team is learning in this context also, through peer coaching across the different professional roles within a team. During the Institute, telelearning faculty members will offer support and will lead workshops, either in face-to-face or virtual situations. Teams will develop relationships in face-to-face contexts, and they will plan ways of continuing these relationships online through e-mail, joint Web design, and discussion forums. As such, the work of student-teachers in the school becomes a continuation of relationships and previous conversations. Activities prior to and following the Institute will ensure that the Institute is embedded within on-going practices at the school and the Faculty. For example, a site-based McGill course on "Integrating technology in the classroom" is offered to schools where a group of teachers (in some cases with students and parents) wants to meet regularly to develop new knowledge and skills in this area. We foresee PDWs becoming another key activity, in addition to courses, seminars, and practica, for universities' professional schools.

Conclusion

The social and cognitive circumstances that seem to be required for successful networked learning communities in teacher education - as those mentioned above - are still at an early stage of conceptualization. Networked learning and teaching is indeed a whole new practice, one likely to gain greater relevance while the demand for education keeps increasing as we move in the Knowledge Age. The initiatives described in this paper are part of our "local" endeavor to design a "teacher education culture that promotes curriculum experimentation, collaborative learning, faculty development, and better linkages to P-12 schools" (NCATE, 1997b). Our approach is to start with a critical mass of participants, and then to celebrate and publicize success (Mergendoller, Johnston, Rockman, & Willis, 1994).

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Web Sites

TL-NCE : CSILE *TeleLearning Network of Centres of Excellence: Computer-Supported Intentional Learning Environments* URL: http://csile.oise.utoronto.ca

TL-NCE: Studio A.*TeleLearning Network of Centres of Excellence: Studio A.* URL: http://www.knowarch.com

TL-NCE: TACT.*TeleLearning Network of Centres of Excellence: Télé-apprentissage communautaire et transformatif/Technology for the Advancement of Collaborative Teaching and Training.* URL: http://www.tact.fse.ulaval.ca/

TL-NCE: MCGILL TK.*TeleLearning Network of Centres of Excellence: Teacher Knowledge and Skill for Effective Implementation of Learning.*
URL: http://www.education.mcgill.ca/fedwww/cils/Telelearning/Telelearn.html

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Replacing the Tin Can: Creating an Effective Electronic Communication Environment

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com•mu'ni•cate 1. to impart, transmit; 2. to make known, tell; 3. to be connected; 4. to hold converse; impart ideas or information - Scribner Dictionary, 1977

It is easy to remember fondly the days when we would hold a tin can to our ear which was connected by a string to another tin can and a friend. We would struggle to hear our friend through the piece of yarn. The goal was more the act of putting the device together and less the actual communication itself. The same held true for the childhood game of operator, when one person started a message and the message was whispered from ear to ear to ear, around a circle until the final person said the altered message out loud. Everyone would laugh to hear how the message had changed during the communication process.

However, the simplicity of that type of communication does not work in the classroom. The purpose of communication in the classroom is to impart knowledge and information and to receive feedback. A garbled message will not work when students and faculty are depending upon clear, cogent communication. This need is particularly true in the realm of teacher education when not only is communication necessary for the learning process, but as a modeling process of effective classroom communication that preservice teachers will use in the field.

To accomplish that mission, a large number of texts have been created to help faculty and teacher alike create a scaffold where communication thrives for all persons. Friedrich, Galvin and Book (1976) break down the communication process into a system of communication where the student and the teachers have specific roles. Gavriel Salomon (1981) examines the richness and reciprocal interactions inherent in classroom communication. Hurt, Scott and McCroskey (1978) return to the classic communication model of source, receiver, channel, message and feedback and relate this specifically to classroom communication and how each piece plays out in the classroom environment. Finally, Cazden (1988) provides specific analysis tools and exercises to enable the teacher to understand the type of communication interactions which take place in the classroom and the variety of roles that are played by the individuals. The books mentioned here are just a taste of what sources are available regarding the facilitation and understanding of the classroom communication process. That process is far more complex than the string and tin can or the ring of friends whispering in each other's ears.

Classroom Communication in the Electronic Age

In an odd way, however, the tin can has returned to our communication system in the way of computer e-mail (i.e., two pieces of metal connected by fiber wire). At the same time, the circle of friends whispering to each other has returned as the electronic discussion group, where a message is passed to everyone. The analogy may seem stretched, but in many ways, the new electronic communication tools may have more in common with these old games than with traditional classroom communication. The charge is to find ways to make the communication more like, and possibly better, than effective classroom communication.

The statement above demonstrates that childhood games are similar to electronic communication tools. The question then arises, how are these forms of communication alike? They would seem remarkably dissimilar in their complexity and expense. However, just like the two people joined only by metal and string, e-mail messages are devoid of nonverbal communication and inflection. The hope is that the person at the other end understood what you were really trying to say. Likewise, the circle playing "operator" is much like the electronic discussion group where an original message is sent, and each person involved receives a slightly different message. The original sender is not able to relay the context of the message to every person and the final outcome or interpretation of that message may in no way resemble the original.

This paper and these authors will not begin to assume that all communication that takes place in a classroom

setting is effective. The face-to-face communication can also be charged with misunderstanding and false communication. However, classroom communication has the value-added benefit of immediacy and the possibility of immediate feedback (Hurt et al., 1978) for the purposes of clarification and consensus of understanding. Models such as these provide teachers with methods to ensure that the "noise" which disrupts communication is eliminated. Therefore, can these same models be applied to the development of an effective communication model for electronic discussion?

Building a Foundation for Electronic Communication

Creating a firm foundation for successful electronic communication must start prior to the models, i.e., before the source sends the message. First, the consideration must be made on whether the technology should be used. The mere ability to use electronic communication tools does not translate into an instructional need for the tool. For instance, perhaps a class meets several times a week and engages in active discussion during the class period and students are readily able to have all topics and questions covered during scheduled class periods. It could be argued that the use of electronic discussion in this instance would possible take away from and not complement the rich discussions already taking place. However, if there are students who are not comfortable speaking aloud in front of their peers, or class time does not permit discussion of issues indirectly related to course topics, or even if students have experiences (such as in preservice early field experiences) that they would like to share immediately instead of waiting for class time, an electronic discussion forum would appear to be a useful tool. When an instructional or student need is fulfilled by a tool, students will not feel a need to use it just to make the instructor happy or just for a grade, and more meaningful communication can take place.

If there appears to be an instructional and student need for electronic communication, the next step would be to determine which type of tool would be used. This step could be equated with selecting a channel for communication and messages. Again the student needs must take precedence in the selection. As an instructor, I may have become interested in the concept of conferencing on the web. However, a tool such as this will require students to have access to a certain level of software and computer in order to have class communication that is not frustrating because of the mechanics. Alternatively, perhaps communication with the entire class is not necessary, and only e-mail links to the instructor need to be established to encourage students to seek information and mentoring from the instructor. By matching the tool to the needs and resources of the students, a foundation is being built that will help support effective communication.

The next step is also entangled with the previous steps and relates to message creation. The specific types of electronic communication that will be sent must be determined and established. Will the electronic discussion be dedicated only to certain topics that are either integral to the course or, at the other extreme, will students be allowed to determine what topics will be discussed collectively. Perhaps students in the class have little time to develop social relationships with classmates, or are unable to do so in a distance environment. Therefore, it might be appropriate to allow students to use an electronic discussion group to form those important bonds with peers. On the other hand, it might also be equally important that students don't want to waste valuable time with trivial information and all communication must be professional in nature.

Implementing the Electronic Discussion

With the above decisions made, the foundation for an effective, electronic class discussion has been set. Now all that remains is the implementation. Implementation may seem to be a simple task, but once again, it is necessary to do some preparation in order to assure effectiveness. The environment itself needs to be built. As much as effective classroom discourse is managed and planned (Cazden, 1988), so too must the electronic classroom be managed. Many of these steps might appear to affect the message development. Their real purpose though is to eliminate the noise that disrupts the receiver from fully understanding, or even receiving, the source's message.

Training the Participants

There are many things that all the participants must learn in order to eliminate noise and hold effective communication. First, can all participants use the electronic tools that have been selected? For example, do all students have an active e-mail account and know how to send and read their e-mail? If web conferencing is being used, do students know how to input their information in a web form? Also, if a listserv is being used, does the faculty member have the knowledge to moderate the list? To ensure that everyone has the same basic level of psychomotor skills, it might be necessary to provide class time to learn these skills, or workshop time to do the same.

When you consider classroom discussion, there exists a certain degree of etiquette and a code of conduct. Students have learned not to interrupt the instructor. Students will usually raise a hand before speaking, or at least look to see if someone else is about to speak. For the most part, students and instructor alike are respectful of each other and allow each other to complete thoughts without interruption. These standards of behavior are not something that must be taught at the beginning of the class; instead, those skills have been learned over the years as students travel through a variety of educational levels.

It would absurd to assume students will enter an electronic communication environment and be able to achieve the same skill level they have obtained in face-to-face communication. In the first place, electronic discussion gives the user a certain level of anonymity that empowers individuals to say things they may not have said before. This empowerment may be to the betterment of the class as students who may not speak in a classroom environment now are willing to discuss issues and communicate with others electronically (Powers & Mitchell, 1997; Powers & Dutt, 1997; Johnson, 1997). However, the anonymity can also permit individuals to say things they would not ordinarily say to another person if they were sitting in a classroom together which might be to the detriment of the class environment.

Developing Guidelines

There are other skills to be learned to help eliminate noise. The written, textual base of words do not necessarily carry the same meaning as the spoken word. In other words, I may say something harsh in a classroom discussion to provoke debate. However, through the use of my body language, facial expression and tonality, I can soften the words enough that they will in fact provoke debate and not insult. Through the text of electronic communication, I am not able to convey all those communication tools that are outside of the words. I would therefore need to find different words and phrases that will accomplish the same mission and purpose and not offend or insult.

For basic Internet usage, there is reference source of online etiquette principles called "netiquette." These are core rules of acceptable behavior for online interactions, such as Virginia Shea's Core Rules of Netiquette (1997). These rules cover issues such as saying electronically only what you would say to someone face-to-face, ethics, sharing expertise with others, and forgiveness. Groups take netiquette guidelines such as these and adapt them to their specific needs. For example, Augsburg College (Mateer, 1996) has posted a list of guidelines with which they hope to guide their constituents. These guidelines also deal with issues of respect, educate users about how inflections in voice can change meaning and the related problem of not having that inflection present, and how the mere typing of text (e.g., all capital letters come across like shouting) can change meaning. By compiling these guidelines, Augsburg College is hoping to influence its community of electronic discussion.

The same process of "guideline creation" or adaptation of netiquette principles can take place at the classroom level. As mentioned previously, classroom communication generally takes a certain shape based on the years of experience the participants have in classroom discussion. Even when an instructor wants to change classroom discussion, students must be informed of the "new rules." For example, if an instructor wants students to jump in with comments at any point during a lecture, the students will probably need to be informed that it would be considered acceptable behavior. Therefore, we should expect electronic communication, which is undoubtedly new to many of the participants, to need the same level of permission and information.

Before the first electronic discussion takes place, the instructor needs to develop guidelines and criteria that are specific to that class. These guidelines would incorporate many of the decisions made previously in the process, such as whether social conversations are appropriate or if all communication must be professional in nature. The guidelines can include provisions for who can participate in the discussion; for example, will the instructor take the lead role in answering questions or initiating communication, or will all participants be considered equal. The guidelines can be even more basic and cover issues such as whether or not aliases will be allowed by individuals or must a student's identity always be obvious; whether or not signature lines can include items of a personal nature (scripture or sayings); preferences for responses to messages (should original message be included and to what degree); whether spelling and grammar is important in messages. Finally, the repercussions for violating the class policy must be codified.

Generally speaking, students are informed at the front end as to what the penalties will be if they, for instance, miss class or fail to complete assignments on time. If the electronic communication is truly a part of the classroom communication structure, the same information and repercussions must be made available to students for that part of the class. The instructor must decide up front whether students who abuse the electronic communication system will lose those privileges, and how that will impact their performance in the class. At one end of the spectrum, there might be no impact on final class outcomes, at the other end of the spectrum a student may not be able to successfully complete the class without the electronic communication. An instructor must decide whether there will be a series of warnings, or if there might be offenses severe enough to warrant immediate removal. Opinions and options will vary on this issue. However, the consideration must be made that our students are being prepared for participation in the world at large. It is far preferable that students make these types of errors within the confines of our educational system where we can work with the students and help their understanding, than to have them make these same mistakes in electronic communications that may be worldwide. Our education of students should extend beyond content and should include the tools for transmittal of content.

It could be argued that these principles and guidelines could be achieved through modeling by the instructor who would pay special attention not violate her own guidelines.

However, the instructor is not a peer and students will not be privy to all of the communications that take place, as in the case of private electronic communication. The modeling will help support the guidelines and give the students examples, but the overarching classroom electronic communication principles will provide a scaffold for students as they develop their communications.

Faculty Role

As one additional way to eliminate noise, faculty must also consider their level and type of participation in the electronic communication process. As with many teaching decisions, the purpose for implementing a teaching strategy must be considered when deciding the role s/he wants to play. For example, an instructor could choose to use an electronic discussion group to address specific topics related to course content; or, the instructor could decide to use an electronic discussion group to discuss issues related to the course that may or may not be addressed in class. In this last example, students would drive the message design by posting issues that have interest to them. In all of these scenarios, just like with regular class discussions, the instructor must decide his/her level of participation in the discussion. Confusion about faculty roles will create noise or disruption for the student as s/he struggles to determine the role as student. In any case, whether the instructor participates in the electronic discussion on a regular basis or chooses to step aside, the instructor must find a way to communicate to the students that s/he is reading the ongoing discussion. In this way, students still feel a responsibility to participate in the electronic discussion and know that the instructor cares about the ensuing discussion.

Specific Thoughts for Teacher Education

Recent teacher education reform movements including the National Board for Professional Teaching Standards (NBPTS), National Council for the Accreditation of Teacher Education (NCATE), and the Interstate New Teacher Assessment and Support Consortium (INTASC) acknowledge the need for beginning and experienced teachers to demonstrate competence in the use of technology as well as effective communication skills. Integrating electronic communication into teacher preparation courses not only provides students with exposure to technology-related communication, but also provides students with an opportunity to practice effective communication skills in new contexts.

In addition, it seems that professors of education are always concerned with the over abundance of content to cover during class time, especially now as field experiences become such a critical component of many teacher preparation programs. Electronic discussion can provide instructors with opportunities to use other forums for communicating with students and provide students with other forums for communicating with each other. As a tool, it provides a vehicle for students to share ideas, discuss topics, ask questions that would otherwise take up class time. It is also an effective way to open communication lines while students are out in the field.

Conclusion

Returning to the definition provided by Scribner on communication, we see that to communicate means to impart or transmit, to make known or tell, to be connected, and to impart ideas or information. All of these aspects, molded together along with the deliberative design of the communication system will create an effective electronic communication environment for classroom discussion. In a condensed form, the instructor must:

1. determine the instructional need that would indicate whether or not electronic communication tools should be used;
2. determine exactly which tools would be used to implement an electronic communication system, again dependent on the student and instructional needs;
3. determine what forms of electronic communication will take place;
4. train all participants on the various uses of the technology;
5. create guidelines or principles related to the use of the electronic communication;
6. provide training and information on the proper, ethical use of the communication tools; and,
7. determine faculty role of management and facilitation.

Effective electronic communication can take place without all these decisions being made and this advanced planning. Some classes of students contain the capacity and critical mass to be able to approach these tasks without problems. However, the risk and outcome of unsuccessful electronic communication may be too great and may prove to be too heavy a burden on the class as a whole or the individual participants. By carefully planning this discourse, much as other parts of a class are planned, a beneficial environment can be more assured.

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Curry CONNECT: How Online Discourse Creates Community for Education Students

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How can fledgling teachers and administrators begin to develop the habits of professional collegiality and collaboration when the "closed door" mentality, symbol of the traditional K-12 classroom isolation, is also alive and well in schools of education?

At the University of Virginia's Curry School of Education, we have been exploring ways of cracking open those doors by facilitating communication among education students through an innovative project, Curry CONNECT. Curry CONNECT is a Web-based discussion group that links preservice teachers with graduate inservice teachers and apprenticing administrators.

In this paper, we will report on what we're learning from this project. Using content, survey, and interview data collected from the discussion postings and student feedback, we will present a qualitative analysis examining the nature of the participant discourse as it evolved over the semester. In particular, we will consider the following questions: Does the evolving discourse reflect the growth of a shared community of understanding among the participants? How does the motivation for participation affect the discourse and the development of a sense of a collaborative community?

Perspectives

Curry CONNECT – Rationale

One important result of the practice of university teacher education students working in isolation is the lack of opportunity for them to interact with each other about important concepts and issues. Student-to-student interaction usually occurs within a classroom through cooperative projects or discussion but rarely goes beyond the classroom. Preservice teacher education students have little time to communicate with one another or with experienced teachers when they observe or student teach in K-12 classrooms. Seldom, if ever, do they have the opportunity to exchange ideas with administrators. Yet we accept as the basis for much of what we teach today in education that real learning takes place in a social context. From Dewey (1916) and Vygotsky (1978), we have developed learning theory which is predicated on the idea that knowledge is socially constructed. As learners, we are actively engaged in the production of shared "communal understandings" which help us to derive meaning from everyday messy, puzzling experience. Through encounters with multiple perspectives, we acquire mature and mutual understandings about the nature of reality (Sugar & Bonk, 1995). By providing future educators of all stripes with a common social context in which to discuss ideas and build meaning, we can facilitate their learning. We believe that technology has the capacity to bring together such diverse groups of students-in different classes with varying degrees of experience-to exchange ideas and knowledge.

Curry CONNECT – Design

The instructors of seven educational technology courses (four undergraduate classes, three graduate classes) created a Web-based discussion group, Curry CONNECT, for their students to engage in online discussions about issues related to the use of technology in education. The underlying purpose of the Curry CONNECT project, however, was to build a virtual "community" in which preservice teachers, inservice teachers and interning administrators could develop the understanding that they are part of a larger educational community which can provide them with support, challenge, and an enriched social context for learning. An electronic link among the classes was selected as the best method for creating this perception (Bonk, Appleman, & Hay, 1996).

Students accessed the Curry CONNECT Website to discuss common readings about educational technology designated by the instructors. The Website is available at the following URL: http://curry.edschool.virginia.edu/go/connect. After an initial "practice" discussion in which

students could post and respond to any idea, we held three discussions based on common readings.

Methods

Participants

The classes were comprised of the following students:

- *Introduction to Educational Technology* (Undergraduate, four sections-primarily preservice elementary and secondary teacher education students)
- *Instructional Computing* (Graduate, one section-primarily graduate teacher education students, most of whom were experienced teachers)
- *Educational Software Applications* (Graduate, one section-a diverse group of students from the entire university)
- *Problems in School Business: Computer Applications* (Graduate, one section-experienced teachers and administrative interns working on graduate degrees in school administration)

These students offered a breadth of classroom experience to the discussion group, ranging from those who had only observed in classrooms to those who had taught for many years. It also included a contingent of students from other schools of the university who were not interested in becoming teachers. Mostly undergraduates, these students represented the important constituencies of future parents, business leaders, and other professionals for the education students in the group.

Data Collection and Analysis

Curry CONNECT consisted of the participating classes (approximately 140 students total) and seven instructors. Participants were identified by their "roles" within this educational community: Preservice teachers, experienced teachers, administrators, those characterized as community members (non-education students), and Instructors.

In addition to follow-up surveys provided to the entire population of students, we selected two students from each class, who had posted to the discussion group, to follow during the course of the semester. These students, or "posters," were interviewed following each discussion to gain insight into their views on the nature of the discussion, what they learned from the experience, and how they felt about the other participants in the discussion. "Non-posters" from each group were to be selected and interviewed at the end of the semester course to determine reasons why they chose not to participate. Finally, instructors from two of the courses were interviewed.

The results of the surveys, the interviews, and a discourse analysis on all of the posted students' responses were examined qualitatively with particular emphasis on the following questions:

1. Does the motivation for participation affect the quality of discourse and the development of a sense of participating in learning community?
2. Is there evidence that the evolving discourse reflects a sense of community (shared communal understanding) among the participants?

Preliminary Results and Discussion

Interviews and postings were analyzed and content analysis was performed. The following categories were determined to be important indicators that respondents were describing a sense of participating in a shared community:

- Motivation for participation which is primarily internal
- Awareness of the social context of the discussion group and perception of other participants as peer members
- The ability to acknowledge and appreciate multiple perspectives

Discussion One. "The Computer Delusion" (Oppenheimer, 1997) provided the topic for discussion. A link was available from the Curry CONNECT site to an online version of the article at: http://www.theatlantic.com/issues/97jul/computer.htm.

This was a relatively straightforward discussion arising from a single reading. Responses provided a lively back and forth debate surrounding the issues raised in the article with participants about evenly split either for or against the author's position. The following are excerpts from the discussion:

> We all agree our children will need more computer skills in the future and we probably all agree that we need to spend more money on education in general, so why not use capitalism's competitive nature to solve all of our problems. Let the public sector spend more on the traditional programs and let the private provide the rest. (Experienced teacher's posting)

> ... your argument of private vs. public spending sounds great on the surface, but what about the long-term effects? Won't this cause great disparity among schools? The richer schools will get richer and the poor school districts will remain poor. We will create a greater disparity among schools than what we presently have. Is this fair to all students? I don't think school choice is the answer to this dilemma either. It is our obligation as a free society to provide an equal education to all of our youth. (Administrator's response)

Discussion Two. The general topic was Censorship and Copyright Issues. Links were provided to several sites that provided information and articles on these issues at: http://curry.edschool.Virginia.EDU/go/connect/discussions/

copyright/auprdgs.html. The format was somewhat less structured since students were required to look up a number of resources and links in order to develop their own understanding of the issues.

Although the format was more problematic for some students, participation was high and multiple perspectives were evident in the series of postings. The following example demonstrates one discussion strand that arose about "censorship" on the Web:

> ...Part of the skill required to make the Internet experience into a meaningful learning experience for the student, teacher or parent is found in gaining the ability to discern. Access to the Internet-and all it has to offer-is growing exponentially. I don't believe that we could or should exercise control over users' exposure... (Preservice teacher's posting)

> I'm not sure that I agree-though in theory I think your ideas are marvelous, I can see a lot of adolescents not grasping the deeply rooted concept. Education about the craziness that exists on the net should certainly be addressed, but I'm not sure that would keep an eager adolescent from learning too much too quickly. (Experienced teacher's response)

> I met a man once who was very disconcerted by television sets. He did not give the normal speech about TV being trash or a waste of time or not educational. He saw televisions as a very disturbing invasion of privacy. He said, "Yesterday when I came home from work a strange man I had never seen before was talking to my daughter in the living room."...I think the fact that TV and computers allow millions of strangers into our lives is indeed quite disturbing. I do not believe that the net should be censored but I do not believe that it has much of a place in schools...Internet access in schools is like having tax-funded strip dancers in off limits classrooms. (Community member's comments)

Motivation for Participation

We asked participants what initially motivated them to participate. Interest in the topic was given as the primary reason by most participants as indicated below:

> I think that the impetus behind my posting in that particular circumstance was based upon the article itself. I was so enraged by the opinions put forth [in the article]. (Experienced teacher)

> I think that I read the article, and I thought it was interesting, so I wanted to comment on it. (Preservice teacher)

> I've always heard things about censorship on the web, and I wanted to look into it. When I did I went to a lot of the sites, and I was really surprised with what I found. I think I gave some examples in what I wrote-the things that really shocked me. (Preservice teacher)

Of equal importance to respondents was finding out what other people thought:

> I think I was interested in seeing if other people saw things the same way I did. (Preservice teacher)

> I was curious to see what other people posted. (Experienced teacher)

Although most students noted that there were course expectations or requirements for their participation in the discussion group, only one mentioned this as the sole motivation for involvement.

> I liked the topic, but the only reason that I posted was because it was part of an assignment. (Community member)

Instructors cited the importance of responding to their own students' posts as their main motivation for posting to the discussion group. One wrote "...it's very difficult for people when they post something and don't get a response at all. It's one of the worst feelings in the world to not get a response from anybody. You start to wonder whether you had anything worthwhile to say or what folks' reactions are to your message."

With one exception ("I did not want to see the responses people might have given to my particular response."), all of the student participants reported that, indeed, they were motivated to return to the discussion on several occasions after they had posted in order to find out what others may have responded to them.

> I wanted to see if people had responded to what I had written. And it was new to me-the whole newsgroup thing, so I just wanted to see how it worked. So I looked at some people's comments. Not just who had responded to me, but some people that I knew-I wanted to know what they thought of it. (Experienced teacher)

> I returned [several times] to see if there was reaction to my posting. (Administrator)

Internal/External Motivation

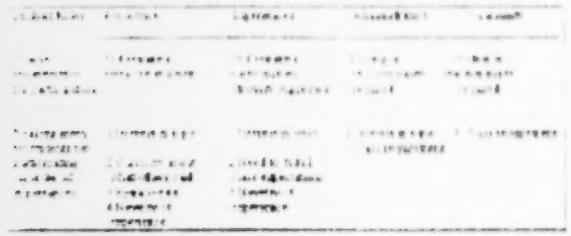
All students taking part in Curry CONNECT discussion groups were presented with some form of extrinsic motivation for participating. Reading the common resources and posting to the discussion group was required, suggested, or encouraged by the course requirements in all of the classes. It was, therefore, a matter of interest to examine the effect of these requirements on student motivation.

Two classes were given the option of either posting to the discussion group or submitting a reading reaction paper

to their instructor. In the third class, students were "strongly encouraged" to post although there was no mandatory requirement that they do so. In the fourth class, while again there was no mandatory requirement for posting, two extra credit points were awarded to students who joined in an online discussion.

An analysis of the interview data suggests that for the non-education students, required participation became the chief motivating factor in their involvement; whereas for those students engaged in education and anticipating a career in the field, interest in the discussion topics and themes was cited as more important or equally important. Except for one student, all respondents were motivated to return to view the discussions thereafter more than once.

Table 1.
Comparison of motivations to participate



Awareness of Social Context

We were curious about the participants' perceptions of the other members of the CONNECT group.As one instructor interviewed put it:

> ...obviously the literature shows that when you have familiarity with people, you know the person, that there is more of a chance that you would talk to them again, and the same on the Internet. It opens the chance to talk to a whole bunch of different people, but given the choice of talking with somebody you know and somebody you don't know, you're more likely to talk to somebody you know-unless somebody you don't know really says something controversial and you just absolutely have to respond to them.

All respondents were clear that they felt the Web discussion was a significantly different experience than a face-to-face encounter.

Some students clearly didn't feel that they were involved in a "discussion:"

> I didn't really feel like I was participating in a discussion. I thought I was just putting on a comment to see how other people would respond to it. (Preservice teacher)

> I did not get the feeling that I was participating in a real discussion. I consider a discussion more than just a written response to somebody else's thoughts. (Community member)

Several, however, did indicate that they felt there was a conversation taking place and especially approved of the asynchronous nature of the format:

> But yes, I think I thought I was participating in a discussion. That it was there. Those that were interested in a topic could read, react and that type of thing...It was very convenient in that you could do it on your own schedule and time. (Administrator)

At least three students we talked with appeared to find both liberation and the ability to reflect in this form of discussion.

> I thought it was pretty close to what you have in class. Except you do have the time to actually think - ....I think I wrote in things that I wouldn't have said in person. (Preservice teacher)

> ...although there will be certain tones and moods when you can note from the reading. Writing is a physical manifestation of spiritual thought and there's a transformation that occurs from the thought to the paper. I guess that what I'm trying to point out is that when we read someone else's writing we read it in their voice. That's why you get a sense of a person's mindset. That's why it is a viable level of communication-discussion groups. We're touching one another. (Experienced teacher)

> It's more than just words on a screen. It's really communicating. Writing is thinking. Sometimes I don't know what I think until I write it down. (Experienced teacher)

Acknowledgement of Multiple Perspectives

One of the most crucial themes to our investigation into the nature of how a community builds relationships and constructs meaning arises out of the apprehension of the multiple perspectives which can only present themselves in a social context. There was evidence from our respondents that such a process was beginning to take place.

> I have to admit I was surprised. You get so insular sometimes-as we all do all the time in education in general-and you forget that there's a whole world out there that doesn't read the same books, use the same jargon, share the same ideas. (Experienced teacher)

> I think a lot of people felt the way I did-they just felt more comfortable writing it than would just raising their hand and saying it. I think you got a lot of different opinions. I didn't expect a lot of different opinions. (Preservice teacher)

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It helped to give me some insight to their ideas and views which a lot of the time were different from mine. (Preservice teacher)

By reading the responses of other people, I was exposed to different views and opinions than my own. Word choices and tones conveyed in the postings helped me see where the students were coming from. (Community member)

Future Research

We will continue to investigate the extent to which our results indicate that the Curry CONNECT discussion group succeeds in its mission of creating a "shared community of understanding" among education students and make adjustments to its use as necessary. As in the real world, we will need to be sensitive to finding ways to involve community members more thoroughly in our mutual meaning making.

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From "Knowledge Sharing" to "Knowledge Infrastructure:" Lessons from a Virtual Professional Community of 250 Israeli Educators Who Used 18,000 Web Pages

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The Lamda Community project was created to "use the Internet to support science and technology education" as part of the Israeli national program "Tomorrow 98" or in its Hebrew name, "MAHAR 98" to "advance science and technology education in Israel. (For an extended discussion about the project see Sivan, 1997; Sivan, In Press). The following paragraphs describe the project's 1994-1997 history.

- In the first year, 1994, we conducted a general overview of network technologies, and their potential educational use both in Israel and in the world. This initial examination revealed what we then called "a messy situation." It appeared that beyond the usual challenges of "large scale changes in K-12 education," educational research and practice lacked a clear understanding regarding the role of networks in such a change.
- In the second year, 1995, the first 50 members joined in and an initial 100-page Web site was created.
- In the third year, 1996, we started the actual development. By the end of the year we had about 150 members who used 5000 static Web pages, and about 5000 dynamic pages (mostly in the discussion centers). Among other things, the Lamda site included a dual e-mail/Web discussion center; weekly news; automatic front page and support for project-based learning; and various content centers in the area of science and technology education.
- In the fourth year, 1997, we started to realize the true nature of professional development over networks. 1997 became the year of realization. After two years of operation with about 18,000 Web pages that serve 250 members, we began examining our initial ideas about using the Web to support professional development. (See Figure 1).

Perspective Theoretical Framework: A Call for New CMC Understandings

Since the 1970s, the term Computer Mediated-Communication (CMC) has been used in education (Harasim, 1989; Rice, 1992). Concepts like remote learning, copyright, lurking, MUDing (Multi User Dungeon), and other CMC lingo have appeared in the literature. While Rice (1992) says "there is little theoretical or empirical research in this area" he, with others, published a few hundred papers about CMC.

Such pre-1995 research dealt mostly with text-based systems that were used by computer users. The "text-ness" and the "computer-ness" of CMC have changed dramatically with the emergence of the Internet. As of 1996, even novice users can use CMC with relatively easy-to-use Graphical User Interfaces (GUIs).

Three factors led to the demise of "text-ness" and "computer-ness" of CMC. These include the development of Point to Point Protocol (PPP), the World Wide Web (WWW), and an improved cost/speed ratio of modems. The combination of these three factors created the initial boom of the Internet, a boom that has changed the field of CMC. Let me therefore humbly argue that the value of pre-1995 research mostly stemmed from suggesting concepts and issues. Yet now we must take a fresh look at the relations between these concepts and the real world. CMC terms like, remote learning, copyright, lurking take on a different meaning when millions of users are involved.

Lamda Community was designed to examine the new meaning of CMC. Lamda Community was not a classic experiment; it was designed to be a self-evolving experiment in the tradition of action research. The community is designed to foster an iterative interactive process among three factors: the members, the material on the Lamda Community site, and the technological systems supporting the community. The research questions of the project

revolve around the nature of professional virtual communities. More specifically, we were looking at user-network interaction, site design, authoring of CMC content, the building of sub-communities, and project-based learning.

Methods

Three kinds of data were collected: use data; online reflection; and focus groups. They are described next.

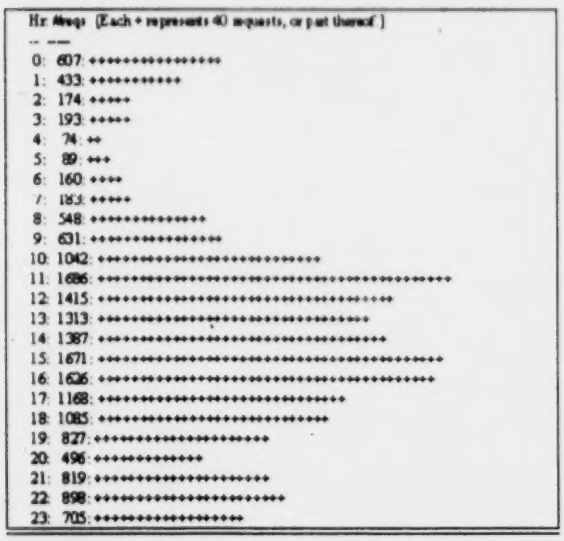

Figure 2. Hourly summary of use in June 1996.

1. **Use data** - The Web allows real-time capturing of data of members' behavior. Since all members must logon to the site we are able to know who used which service. For example (see Figure 2), we can see a decline in use around 8:00pm (possibly due to family time). The numeric data allows us to analyze patterns of use (e.g., novice vs. expert use of the site; the appeal of various services, etc.). Further cross analysis (e.g., kind of member vs. kind of service) allows us to fine tune and adjust the services.
2. **Online reflection** - beyond the quantitative data that we get from the system there is also the automatic capturing of discussions. The main forum for discussion is called the "Discussorium." The Discussorium combines both the capturing of the data (into Web pages) and the links to members via e-mail. The qualitative data is stored for future reference and study.
3. **Focus groups** - each month we gather with members to explore the state of the community. Valuable data and ideas are generated in these meetings. The meeting are logged and transcribed for further study.

Results: From "Knowledge Sharing" to "Knowledge Infrastructure"

Phase 1: The End "Knowledge Sharing"

When we started the project, we, like many other Internet veterans, advocated the idea of virtual communities (e.g., members will start discussion groups; members will share information with each other; when asked, members will contribute their knowledge). This "free flow of knowledge" idea was well phrased in the concept of "virtual communities." The pre-1996 CMC literature reports, and often praises this notion of sharing and collaboration.

In the first years, based on early observations, we thought that our Lamda was indeed a virtual community. Few members started some discussions; few contributed papers to the library; few even answered questions. Later we realized that these signs were misleading. Apparently the few members who acted as members of virtual communities were themselves "good old Internet advocates" who believed in the idea of knowledge sharing. They were especially active in Internet issues (e.g., where is a good site for biology, how to use Netscape, how to read Hebrew on the net).

In 1997, while these good old "Internet advocates" were still using the Lamda community, they became a minority. Within the 250 members, the Internet advocates' activity was felt but it was no longer in the center. Members seemed to want something else.

Phase 2: The Rise of a Knowledge Infrastructure

So what do members of the Lamda community do after all? Our preliminary research shows that members basically do three things (which we have termed as using a "Knowledge Infrastructure"):

1. **Use professional services that the community offers** These include a links database (each entry includes a 5 line description in Hebrew followed by a picture); a search center where members get help with searching, including a human search assistant; and use of content databases.
2. **Participate in a small group discussion concerning a particular topic** For example, one experimental school called Cramim, where all the teachers are connected to the net, joined in and opened its own discussion group. They use the "Cramim-all" list to exchange various messages. They used the list for professional work and seemed comfortable doing it. Another list called K6, which deals with computers in the K6 area, is also very active.
3. **Contribute to and benefit from the entire community** Few, especially those who are advocates of the old Internet tradition, still contribute to the community in the tradition of a virtual community. Most simply enjoy the action passively.

Supporting Evidence

We have not yet completed a full analysis of our data. Our claim regarding "the rise of knowledge infrastructure" stems mostly from anecdotal evidence supported by some theoretical base from the literature of knowledge management.

Consider the following quotes taken from the online reflection made by members of the community:

- " . . . in this age we can not continue to contribute and survive with out getting information and help. Who can go to 300 workshops a year to get some info? I foresee in the very near future that most of the workshops will be done via the net."
- " . . . during the last 2 years, the community have succeeded to build a group of 250 members, create a wide infrastructure in various subjects (math, science, computers in school, biology and more) . . . What was especially unique is the ability of members to build their own centers by creating mini libraries or moderating conferences."
- " . . . the great potential of the community is to allow teachers to develop themselves without the limitations of time and space . . . . The ability to get high quality info is critical to my work as a teacher."
- " . . . it is somewhat difficult to fully describe the sense of the community that I feel. The links with the team members [staff people], the reading of news, cool sites, hi-tech corner, getting feedback from members about my work etc. [became part of my professional life]."

Equipped with the prism of a "knowledge infrastructure," one can see how the members use the community to find, seek, and publish knowledge. The literature of knowledge management (which is now emerging at a rapid pace) involves "technologies for knowledge management" (Davenport, 1998); "new technical processes and tools" (Leonard-Barton, 1995); and "rethinking structure [with technology]," in the case of the Swedish based Skandia (Edvinsson, 1997).

To some extent these authors and others link the managing of knowledge with a technological infrastructure. We, at the Lamda community, came to the same conclusion - albeit from the practical side - from observing what people did within the community.

Implications

Much of what is true for a group of 10-20 people who use the Web ("knowledge sharing") is simply the opposite when it comes to large-scale communities. In this project (with its 250 members, 18,000 Web pages), I believe we named a lasting motivation ("knowledge infrastructure") for teachers to use a particular community.

In more general terms, CMC systems for education seem to be positioned to become a critical factor in creating a sustainable improvement in education. We must be careful not to treat the Internet like we have treated all other technologies. Decades of misuse and underuse of technology in education are in the way of using the Internet. Indepth analysis and treatment like the one we have undertaken within the Lamda community will hopefully allow education to make the best of this new social technology.

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Web Site Evaluation Project Teaching Critical Thinking and Research Skills

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In the process of creating an electronic reference resource, a customized directory, students gained many useful skills. Students learned about Web searching, about search engines, and Web directories. They learned how to evaluate Web sites; they developed criteria for rating the sites, and after rating the sites, they categorized them. They titled their directory *Where We Went on the World Wide Web*It gave them ready access to information about sites that they decided worked best for their assignments and extracurricular interests.

While searching the Web, students access a vast amount of information of varying quality and need to know how to evaluate it. For example, one of the fourth grade assignments is to do a report on birds. Each student is assigned a different bird to research. Being only generally familiar with basic usage of the Web, students as a class come into the lab with the assignment to see if they can find information on their bird. Our browser default is set to Yahooligans (http://www.yahooligans.com). Students start their inquiries there and then are allowed to use other search engines and directories. Some find useful information, but most discover firsthand just why it is valuable to have research skills and an effective strategy to be successful.

Perhaps, students researching cardinals will bring up information about the baseball team. Another student might find sites produced by a university, a commercial organization and another elementary student respectively. They will need to know how to differentiate between the different types of sites and validity of the information found. As Kinnaman (1997) has said:

> The beauty of the Internet is that it holds the potential for each of us to be the captain of our own ship on the sea of information. If we learn how to organize and apply information, access to it will certainly yield knowledge, and through experience, even wisdom.
>
> More than ever before, we need to teach our children the art of critical analysis, so that they can detect and avoid the dangerous assumptions that threaten to sink their ships and drown them in irrelevant and misleading information. (p. 72)

This project was designed to help students and staff learn to navigate the vast sea of information on the Web. After learning about selection criteria and seeing examples of other directories for comparison and evaluation, a customized directory will be created and used as a reference source. It will be added to by students and staff and updated on an ongoing basis.

The Project

The first lesson of the project is an explanation of search engines and Web directories. We access a Web site that contains much information useful in searching and includes a slide show, that explains the difference between search engines and directories (Schrock, 1997). Several good examples of directories are shown. While on the Web, we review how to access the various engines and directories.

A site called *K.I.D.S.-Kids Identifying and Discovering Sites* is accessed (K.I.D.S., 1997). This site contains reviews of sites by K-12 students. Some of the reviews that are provided on this site are discussed, as are their site selection criteria. Next, students are asked to think about what criteria would be most helpful to them.

When presenting to the staff, we explore a site that contains a bibliography of sites concerned with evaluation of Internet resources (Auer, 1997). At least one site is examined and discussed to identify evaluation criteria (King, 1997). After exploring information about selection criteria and evaluation of sites, a checklist of criteria is produced to be used as a starting point to select criteria that will be used in evaluating sites for their own directory. Below are some possible criteria the checklist might include:

- easily accessible
- accurate information
- provides links
- appropriate links
- significant awards
- appropriate for audience
- appropriate reading level

- accurate spelling and grammar
- well written
- includes bibliography
- content rich site
- useful for curriculum
- valuable information
- current information
- unbiased
- well designed
- interactive
- easily navigated
- provides text alternatives
- easy to read
- well organized
- tables and charts are readable
- helper applications identified
- title is appropriate
- no fee or name necessary to use site
- author can be contacted
- copyright date listed
- last update listed
- author recognized expert, educational or government institution or reputable corporate body

Next, students design a standard form to use to record their evaluation of sites. The form should include spaces for the date, reviewer's name, site title, URL, rating and comments. An area including criteria with check boxes will be the basis for the rating. The more criteria met, the higher the rating. Students decide on the criteria to be included.

The forms make up the pages of their directory. The forms will be inserted into a binder in the appropriate category. Perhaps some forms may be included in more than one category. Several directories are examined to provide examples of how their directory might be organized. Graphic pages to head each category are created in various software programs.

Conclusion

Throughout the year as students and staff research on the Web, they keep track of useful sites by using the form they developed and adding the forms to their directory which is kept in the computer lab. They have access to this book to help them in their research and to find out about other sites students and staff have found to be interesting and valuable. They produce a reference source, a directory, tailored to our curriculum and their interests.

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CaseNET: Teaching Decisions via a Web-based Learning Environment

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In the recent National Council for Accreditation of Teacher Education (NCATE) report *Technology and the New Professional Teacher: Preparing for the 21st Century Classroom* NCATE president Art Wise comments: As technology moves from the periphery to the center in P-12 schools, it should also move from the periphery to the center in teacher candidate preparation. We must all work together to help ensure that tomorrow's teachers are prepared for the challenges of teaching in the 21st century. (pg. 2)

The Office of Technology Assessment (1995) suggested that the successful utilization of technology in classrooms resides primarily in the hands of teachers, and that the training of these teachers is vital for its success.

State and federal licensure agencies advocate standards for the integration and assessment of technology and teacher education. Such advocacy from policy- and decision-makers at all levels of the American educational system certainly may be advantageous to teacher educators, but only when one understands that the true educative value of current technologies such as the World Wide Web lies more in their use as a social medium for enabling effective decision-making, than as another productivity tool. Historically, most of the emphasis on technology within teacher preparation has historically been skills- and competency-based (OTA, 1995), with little context or foundation for its use in the act or profession of teaching.

Cases and Teaching Decisions

Generally speaking, classroom teachers make approximately 60 teaching decisions per hour (Jackson, 1968; Hunt, 1971). Each decision requires the teacher to possess dynamic skills of analysis and a keen sense of situation. Classroom teachers are engaged constantly in an environment where success requires fast, contextually-relevant decisions. The dynamic nature of "thinking as a teacher" is a professional attribute which demands flexibility, analysis, and perspective. Kennedy (1990) suggests that the approach historically taken to prepare teachers for making such decisions has consisted of a two-pronged approach: first, the development of a codified, theory-laden knowledge base, and second the development of useful decision-making skills for situation-based reasoning and analysis. Unfortunately, feasibility issues have generally dictated that these decision-making strategies be conveyed via a more formalized setting-one that lacks connection to any real context-resulting in what some refer to as "inert" knowledge (Risko, 1991). As Bruner (1996) states: "The challenge is always to *situate* our knowledge in the living context that poses the 'presenting problem,'" (pg. 44). The use of *cases* may offset such concerns by offering a method of preparing teachers that most closely approximates the real-life environment of rigorous decision-making opportunities that classrooms afford.

A *case* is a situation-based narrative that requires an analysis of context and an understanding of the idiosyncrasies associated with real-world practicalities, presented to prompt a suggested action or implementation. The case study approach-though not an entirely new concept (Merseth, 1991)-has recently gained prominence in teacher preparation (Herbert, White & McNergney, 1992; McNergney, Herbert & Ford, 1993). Case-methods provide avenues through which the creation of a knowledge base and of an environment for contextual reasoning can be fostered. A case-study method challenges students to examine theories they have learned or are learning and to apply these theories to situations they may encounter in the future. Application of this method in preservice teacher preparation has been shown to bridge the gap between theory and practice (Sudzina & Kilbane, 1992). Although it is impossible for a case to address completely the complexity in teachers' lives, case methods may provide realistic environments through which various decision-making tactics can be applied and investigated (McNergney et al., 1994).

One of the advantages of using teaching cases-specifically, using teaching cases as opportunities for analysis and contemplation-is the ease with which a case fosters *problem-solving and decision-making skills* (Merseth, 1996). These skills include the ability to analyze situations and the corresponding multiple perspectives of those

involved. A teaching case can assist the teacher to "think as a teacher would think" given the parameters of the case situation. Cases influence problem-solving and decision-making skills through the provision of vicarious situations through which educators can gain multiple perspectives and develop skills of analyzing situations from the viewpoints of those involved. Cases provide an excellent arena for the testing of ideas against given conditions-that is, conditions generally agreed upon as critical attributes of the given situation as depicted in the case scenario. Finally, cases used as opportunities for analysis and contemplation encourage the use of technical skills and critical knowledge which are unique to the professional educator. In these ways, the teaching case can assist the student to more ably "think as a professional" given the parameters of the case situation.

CaseNET: Web-based Learning through Cases

CaseNET is a Web-based learning environment where teachers utilize the latest technologies to form communities of professionals who hone their decision-making skills via "slice-of-life" cases (see http://casenet.edschool.virginia.edu, for instructions on receiving a guest username and password). Students involved with CaseNET physically meet during regularly scheduled times at a designated site. Each site is staffed with an instructor, or team of instructors, who use case methodology to guide the students' participation. The online component of CaseNET is comprised of the cases, discussion groups, journals and reference materials. The value of CaseNET lies in the successful integration of teacher development, the Web, and case methodology.

The characteristics of Web-based technology lend an element of realism to the use of case-study methods in teacher education that is otherwise unattainable in print materials. For one, the Web allows for a highly interactive environment-enabling more meaningful transactions among people than any other technology before. Teachers can work together through the WEB, unhindered by space and time boundaries. The Web provides a true multimedia experience-displaying information in combinations of text, video, and sound. This has been an important factor in the successful combination of case-study methods and Web-based technologies. The Web provides an environment through which multimedia cases-those combining various media to provide a richer representation of the situation at hand-are more easily provided. Multimedia cases have high face validity (Herbert & McNergney, 1995). The situations portrayed in the cases are realistic and close approximation of real-life. Therefore, the combination results in an environment which is more accessible and truer to real-life than any other medium through which real-life approximations may be offered.

CaseNET matches the inherent characteristics of certain types of communication tools with learning activities deemed useful for teacher development. Instructors are using technology with an understanding of what it is that students need to do to continue developing as professional educators and also with a clearer conception of what role they, as instructors, play in such an environment. For example, teamwork is an integral component of the CaseNET experience, since decisions in schools are rarely made in isolation. Participants are encouraged to cooperate within teams and to compare analyses across teams in search of solutions to real-life educational problems. In reaction to one of the cases, one teacher commented:

> The teachers in this case didn't always agree on ideas and ways of carrying out projects. This case showed me that teachers must work together and compromise on projects like this and let the students make many decisions in order for it to be successful.

Teachers are encouraged also to forge relationships with participants from other CaseNET sites and to use these relationships as further stimulus for continued reflection concerning case issues. Another student suggested that CaseNET "helped me in self evaluation, self-awareness, and in peer interaction. I find in conferring with other teachers regarding a student or issue, I am much more aware of the perspectives, side issues, etc." In large part, both student and instructor are actively engaged in sharing, questioning, and directly experiencing the consequences of making teaching decisions.

We believe that masterful teachers reflect on life in classrooms. Reflection encourages teachers to think like professionals (Kleinfeld, 1992) through an increased power to reason (Sprinthall & Thies-Sprinthall, 1983). Problem-solving in this capacity is a direct result of teachers thinking about teaching as a composite activity-involving issues, perspectives, and possible courses of action-and making decisions based upon the best perceived consequences (McNergney et al., 1994). What emerges from this view of reflective problem-solving is the five-step process for analyzing cases around which CaseNET is centered. The steps in this process include: perceiving issues, problems, dilemmas, and opportunities; recognizing values and perspectives that drive actions; applying appropriate knowledge; suggesting an action one might take; and examining the possible consequences (McNergney & Medley, 1984; McNergney et al., 1993).

Issues. Cases are grounded in core issues and relevant facts. These issues are identifiable and provide the foundation for the interpretation of that particular situation. Issues may take the form of problems, dilemmas, or opportunities. Problems are issues that one may conceivably solve. Dilemmas are unique problems that have no apparent solution and, therefore, require some type of coping mechanism. Opportunities are simply occasions for improving on a situation which already appears to be

working well, as is. The value of identifying the salient issues contained within a case is perhaps best captured in the following student statement:

> While students in other courses were making bulletin boards, we were dealing with real-life situations, ones that we will encounter in the field. This course helped me to realize the many problems that occur in schools and ways to handle those problems.

Teachers make decisions largely based upon the issues they perceive as timely and important. However, what constitutes "timely" and "important" depends upon situation and context. Therefore, merely identifying categories of issues is insufficient. What is necessary is a recognition of the types of skills necessary to distinguish important from relatively inconsequential. CaseNET provides an environment for honing such skills. As one student stated: "This course presented me with many new issues and helped me develop skills for how to deal with them."

Perspectives. One reason for variability of what may be perceived as salient issues within each case is the fact that various perspectives play a key role in deciding which issues rise to the forefront and which ones are left, for the time being, unattended. One's perspective is often heavily informed by the beliefs one holds about students, about teaching, and about the essential qualities of the content at hand. Teachers make decisions largely based on the interactions of these beliefs. For this reason, an essential component of the case analysis process is an identification of the perspectives and values held by each stakeholder with the case. In multimedia teaching cases, these stakeholders are often students, parents, principals, and other teachers.

Cases provide exposure to various school settings and to the myriad perspectives which are naturally associated with each situation. In so doing, students gain the ability to generate a mental image of each participant's vantage point which the student may use to develop a more robust plan for action. CaseNET participants can draw on the critical perspectives of experts, as well as the professional knowledge of their peers through web-based discourse and repositories of information. These activities are deemed important to teacher development, and most if not all are absent from the more formal, decontextualized approaches of preparing teachers. As one student commented, "To see how people reacted to the situations in the case gives us a running knowledge of how things could happen and what we could do to change it."

Knowledge. Knowledge is the component that distinguishes teachers as a community of professionals who know things that others do not. This professional knowledge is informed by practice, theory, and research that teachers may draw from and bring to bear upon the problems represented in each case. Such knowledge provides the foundation and support for the actions one may suggest as appropriate for addressing these problems. Knowledge resides in multiple sources. Printed materials, previous experience and theoretical pieces-may all be valuable resources for making informed decisions. The current that runs throughout each is the fact that knowledge is valuable when it is shared among like-minded peers. Solving cases in teams provides an environment where such peers may benefit from the knowledge held by each individual. Bruner (1997) suggests that: "There are things known by each individual ...more still is known by the group or is discoverable by discussion within the group; and much more still is stored somewhere else-in the 'culture'..." (pg. 52). We agree. For this reason, CaseNET provides several avenues through which participants can communicate and share professional knowledge-through discussion groups, journals, videoconferencing, and other social technologies.

Action and Consequences. At some point, teachers are required to *do* something in their classrooms. The five-step process for case analysis suggests that, after considering the issues, perspectives, and appropriate knowledge, one might suggest a projected teaching action. In other words, if you were this teacher in this situation, what might you do? It is important to understand that, in most situations, there does not exist one "right" action. Instead, it is quite possible that there may be many defensible courses of action that one would possibly choose to address the issues embedded in a particular case. Such an understanding frees the teacher to begin considering varying courses of action she *might* take, given the situation presented in the case. Pragmatic teachers consider the likely consequences of their projected actions. This consideration consists of both the projected positive and negative repercussions of chosen actions. As teachers become more experienced as professional decision-makers, they become more aware of the fact that not all actions turn out well, and not all decisions have the intended results. It is critical, therefore, for developing teachers to constantly remain aware of the potential consequences of their actions in real-life teaching situations.

Conclusion

The elements of the five-step process described above should not suggest that each situation may be addressed in such a linear fashion. Indeed, context often dictates that one begin at one end and progress in the opposite direction, or even begin in the middle and jump around. The journey from one end of the decision-making process to the other is rarely a direct one, and effective utilization of the process with teaching cases must reflect this as well. We only suggest that, in order to foster a more meaningful system of making teaching decisions, both inservice and preservice teachers take into account each of the five factors delineated in the process. CaseNET is intended as an environment in which developing teachers may learn to "play the

game," within the relatively safe confines of a case-study before making decisions in actual real-life situations. As one student recognized: "Everything we did in the course we will take with us to our future classrooms." Another student offers the following:

> The most valuable part of the course is the interaction with preservice and other inservice teachers. Our class discussions and on-line chats provided the most stimulating experiences. And it is such an eye-opener for preservice teachers and equally educational for inservice teachers to "see" the different ways each of us views a classroom situation. This course certainly offers a wealth of information on the subjects of teacher thinking and expert and novice differences.

A recent report sponsored by the Office of Educational Research and Improvement (OERI) suggests that the use of technology in schools may be a catalyst for the change that is occurring through a concerted focus upon the professionalization of teachers (SRI International, 1996). What we offer with CaseNET is an environment where this professionalization, fostered by case analysis and interactive technologies, is displayed in the quality of the decisions participating teachers make.

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The Internet Genie - Teachers Make a Wish on the Web

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It might be said that education of the past attempted to create students as possessors of information. Today's education must create students as expert communicators and problem solvers. The availability and accessibility of information requires less memorization and more technical skill.

The best, most immediate opportunity to significantly expand our educational horizons lies in the development of the Internet as an education delivery and management tool. Much like the research from the late 70s and early 80s that sought to explore the benefits and justify the use of computers across the curriculum, a great deal of writing now outlines advantages of using the Internet throughout education (Ryder & Hughes, 1997). Such issues as how teachers can begin to use the Internet and setup custom World Wide Web pages for use in teaching are commonly found.

As discussed in Talley (1997), an interactive Web site is included in Pepperdine University's transition to a "virtual university" (p. 69) environment. Positive and negative aspects of learning in a school without walls are described and it is reported that the progression toward cyberspace seems imminent and inevitable. The infusion of e-mail, the Web, Internet-based education (IBE), and all types of telecommunications into virtually every aspect of teaching and learning is an immediate responsibility for us all. The issues are clearly "how," rather than "if"-how to implement, integrate, and utilize, rather than whether or not it is relevant or worth our attention.

Educators Use the Internet

E-mail is one of the more basic and widespread uses of the Internet yet and provides very important communication opportunities for teachers and students. Karayan (1997) examined student perceptions in electronic (e-mail) discussion groups. Although, students resisted the dependence on technology, they were more likely to participate positively in electronic discussions exhibiting more desirable behaviors. Likewise, there was a corresponding beneficial impact on class performance.

The latest buzzword, fad, or preoccupation in cyberspace is the World Wide Web, and for good reason. Not only can virtually any institution, school or educator have their own Web site, very often it is the student who is first to have and develop their own Web page. However, as outlined in Mandell (1997), the Internet offers much more than simply the World Wide Web (Information Systems: Compuserve, GEnie, Delphi, America Online, Prodigy, DIALOG, BRS/After Dark, Dow Jones News/Retrieval, Microsoft Network, CNN and more). These databases, service and retrieval systems offer what amounts to an "online knowledge bank" (p. 281) of information access to companies, organizations and individuals. However, in addition to academic networks (BITNET, USENET), most teachers are likely to be most interested in the direct interaction with students provided by e-mail and the Web.

Although "it appears that the Internet will form the foundation...of the 'information superhighway' that will eventually connect all schools, businesses, and homes" (Newby, Stepich, Lehman, & Russell, 1996, p. 133), it is not without its problems. As recently as two years ago, the Internet for teachers was described as being very rough around the edges. They do acknowledge that developments in user-friendly software for accessing the Internet which would simplify use.

Newby et al. (1996) also describe and support the use of e-mail and bulletin boards for students. This would allow students to communicate with each other and instructors both locally and across long distances. The communication can include everything from sharing information to transferring attached files. A full writing network can be established on the Internet where students share their written work with students at other schools, other classes, and even other countries. Also described are experimental projects where students link to other schools to share data and projects with other students and to conduct general research by accessing on-line database services to read or download information. The sharing of information by students can be extended to using the Internet to interface with local colleges to create a local area network for accessing K-12 student projects at the university and getting technical assistance from college professors and technicians (Sipher, 1997).

The Internet represents an opportunity to break away from being "limited to those potential participants who could meet in a single place at a pre-specified time."

(Burgstahler, 1997, p.61). Education in classrooms without walls (as described earlier) can now include traditional course components such as text and lessons (lectures, handouts, etc. stored on a Web site) and class discussions on e-mail (required contributions by student participants).

Other applications of traditional experiences suggested by Burgstahler (1997) include:

a) student or teacher demonstrations (digitized video and audio distribution over the Web);
b) guest speakers (anyone anytime via teleconferencing or e-mail contributions);
c) library research (a dedicated course Web site, Web search engines, information databases);
d) student assignments (when assigned via course Web site or email, and submitted via FTP or e-mail attachments, feedback and sharing among others is made easy);
e) field experiences for preservice teachers (site visits with location local to student participant, student submits report via e-mail); and
f) examinations (distributed via e-mail).

Other ideas include the creation and use of private "chat" rooms where students over long distances can meet for simultaneous group interaction. Also, more developed Web sites can allow students to take exams interactively over the Internet, online instead of via e-mail. Likewise, field experiences might also be conducted remotely with live video transmissions across the Web without the need to actually visit a classroom in person.

Problems for Educators

As the past 25 years of computer technology in education has demonstrated, there is virtually no end to real and potential problems inhibiting or preventing adoption and integration. Expense, training, education and of course experience are all limitations.

Newby et al. (1996) outlined a number of problems including the nature of the Internet as unregulated and unprotected for safe, productive and effective use by students. Education and teachers can become technologically dependent leaving the complete system subject to functional breakdown or failure. The lack of education and experience contributes to the very real potential for unproductive, superficial and impotent use of the quickly changing Internet.

Alexander, Crowley, Lundin, Mudry, Palmer, and Rabkin (1997) specifically addressed the issues of training for instructors. This author would suggest the more elaborate and global issue of computer education rather than the simpler or more ritualized notion of mere training. Other problems discussed include teachers' need for extra preparation, extra flexibility, and their fear of loss of authority.

Not the least problem for teaching over the Internet involves the security of examinations. Of course a test can be distributed on e-mail or even posted on a Web site for students to access. As discussed earlier, interactive Web sites can administer tests on-line. But, confidentiality and dishonesty among student participants is still a problem. Bicanich, Slivinski, Hardwicke, and Kapes (1997) elaborate some issues for offering tests over the Internet. Most issues (e.g., cost) seem beyond the means of the average classroom. Nevertheless, important insights are discussed in detail. For example, test security may be handled by providing the test instrument(s) at specific times with passwords required and with the access of each participant recorded and traceable. This method probably verified the particular student computer or terminal involved but still may not have ensured the student-user's identity. Thus, the problem continues.

Suggestions for Educators

Potentially the most important suggestion for teachers can be found in Davies (1997). From students' journal writing to PowerPoint presentations, Davies emphasizes the need for advance planning. Teachers should have a clearly defined goal and planned approach when arranging students' interaction with the Internet. For example, with just a little bit of advance research, teachers can target a small number of sites for virtually any topic to enhance the day's lesson or to provide outside work for students as homework, projects or research.

Web sites often have useful linkswhich connect to other sites with links which in turn link to more sites to continually provide an opportunity to explore an almost endless series of resources. There are a number of key Web sites which provide search mechanisms designed to find information on virtually any topic. These tools and other searching techniques can provide teachers with the means for advanced planning or may become the students' tools in the learning activity itself.

Teachers can easily prepare their own relatively simple Web pages for information delivery and other professional activities. Such pages can be organized around courses, instructional units or topic areas to include special links to any desired sites right on the "home" page. Teachers' Web pages can solicit information directly from the student and pass it back to the teacher. Students can view graphics, animation and even real-time video over the Internet all as fundamental components of or added embellishments to instruction.

HTML (hypertext mark-up language) is easy to learn and simple to use in constructing personal Web pages, at least at basic levels. However, new software programs, as mentioned above (Newby et al., 1996), provide easy to use authoring tools for designing Web pages in a WYSIWYG (what-you-see-is-what-you-get) format. Advancements in authoring tools will quickly make creating high-quality Web pages within virtually anyone's grasp.

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A Museum Website that Supports Project-based Integration of Art and Technology in K-12 Education

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The Community Discovered is a collaborative project sponsored by the U.S. Department of Education's Technology Innovation Challenge Grant Program. These grants are awarded for the purpose of developing and refining technological applications with the potential to make significant contributions to school improvement. *The Community Discovered* is one of 19 projects awarded Challenge Grants in fiscal 1995. This Challenge Grant, awarded to Westside Community Schools in Omaha is a project that links art and technology with integrated constructivist curricula designed to transform the education of rural and urban disadvantaged students. The project features a collaboration between Nebraska public school districts and Nebraska museums. The Smithsonian's National Museum of American Art (NMAA), the University of Nebraska at Omaha (UNO) and Prairie Visions are also principal partners in this effort. The Prairie Vision Consortium was established by the Nebraska Art Teachers Association and Nebraska Department of Education (NDE) with support from the Getty Center for Education in the Arts, and includes over 90 public and private school districts in Nebraska. *The Community Discovered* builds upon and extends the impact of the *Art and Technology Integration Project* (ATI), conducted by Westside, Grand Island, the National Museum of American Art, and the University of Nebraska at Omaha. The ATI project received a two year grant from the Nebraska Excellence in Education Council.

In addition to Westside Community Schools, currently participating Nebraska K-12 school districts include the School District of Grand Island, Lexington Public Schools, Winnebago Public Schools, and Omaha Public Schools. These participants represent a diversity of students including significant African American and Latino populations. Urban, suburban and rural communities that feed these school systems are comprised of families with a broad range of socioeconomic circumstances. Further information on *The Community Discovered* can be found online at: http://communitydisc.wst.esu3.k12.ne.us

Basic Concept and Goals

The Community Discovered is a five year project designed to link the use of technology and the visual arts with other subject areas throughout the K-12 curriculum with special emphasis on service to rural and urban disadvantaged students. A principal outcome of the project will be the development of curriculum models of engaged student learning featuring activity-based use of museum source materials made available electronically.

The National Museum of American Art and the Nebraska partner museums are supporting the project in several ways. Digital images of museum artworks are being made available via the Internet with information about each work and model curricula using the work. The National Museum of American Art, the Joslyn Art Museum (Omaha, NE), the Sheldon Memorial Art Gallery and Sculpture Garden (Lincoln, NE), and the Museum of Nebraska Art (Kearney, NE) are currently participating. NMAA has also produced a CD-ROM to provide access to museum art and information for students and teachers with personal computers, but without Internet access. Each summer NMAA hosts a one week inservice workshop preparing participating educators to use the visual arts and technology, to apply the constructivist theory of teaching and learning, and to integrate art resources into content areas. Throughout the school year, educators develop curricular units integrating Internet-based resources engaging students in an active learning process. The 1997 summer workshop presented materials thematically. Subsequently, participants were encouraged to join special interest groups organized by the same themes. The Websites featured in the subject poster session were developed by NMAA in support of the special interest group participants.

Special Interest Groups as an Organizing Metaphor

The themes and their special interest groups served multiple purposes. Educators who have adopted a constructivist approach are accustomed to organizing student projects around themes. Similarly, museum exhibitions often are organized around a thematic perspective. For example, educators participating in the post office murals special interest group reported the following curricular activities:

- Grade 2 - use of post office murals as a primary source to see how artists depict weather Student creation of a mural depicting the 1980 tornado in Grand Island, Nebraska;
- Grades 3 & 5 - use of post office murals as a primary source to explore the social construction of local communities;
- Grade 4 - use of post office murals as a primary source depicting Nebraska history;
- Grade 5 - use of post office murals as a primary source to see how artists depict natural cycles such as seasons, life cycles, carbon cycle, etc;
- Grade 6 - use of post office murals as a primary source to practice analysis of point of view;
- Grade 8 - explicit investigation of the post office mural project in the context of an American History unit on the New Deal. Use of murals as a primary source to practice interpretation of concepts expressed by the artist;
- Grade 9 - in the context of writing and speech, use of post office murals as a primary source to practice skills of analysis and persuasion; and
- Grade 10 - in a World History context, use of post office murals as a primary source to investigate how art (particularly government sponsored art) reflects national concerns. Many of the above units also involved small group student mural creation.

With the above curricular uses in mind, the National Museum of American Art created a set of World Wide Web pages featuring the museum's collection of post office mural studies. As mentioned above, a number of educational telecomputing activities were supported. Examples include:

- Keypals - After looking at NMAA post office murals, students were asked to "read" the images. A post office mural was assigned to each student and keypals were located near the location of the mural. Students discussed the mural with their keypals, examining issues of content and context. Students compared the information obtained from their keypals with their original analysis.
- Simulation - Groups of students from different school were created. Roles of artist, funder, local patron, etc. were assigned. Using e-mail, students role-played their assigned perspective to collaborate on what would be depicted in a community mural.
- Electronic Publishing - a number of school Websites were created documenting post office related student activities.

Similar curricular integration and telecomputing activities were organized for other thematic areas. Web pages supporting the project's special interest groups can be found in the Education section of NMAA's Website at: http://www.nmaa.si.edu

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Lessons Learned from National Park Service Electronic Visitors: Implications for K-12 Classrooms and Teachers

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During the early 1990's Art Hutchinson, in his role as Park Ranger and Coordinator of Education/School Services at Mesa Verde, was exploring possible applications of the early digital information and multimedia technologies. The goal at that time was to provide new experiences for Park visitors on-site as well as for students across the Four Corners region. Hutchinson quickly recognized the initial challenges and opportunities being made available through technology and explored various strategies designed to help meet the needs of adult visitors as well as the young people who make up what is being described as the "Nintendo Generation" (National Academy of Sciences and National Academy of Engineering, 1993).

At the same time, John Parmley was exploring applications of the same technologies to enhance student learning experiences in school settings. Having spent his childhood years in the Four Corners region and being familiar with the Ancestral Puebloan or Anasazi culture preserved within Mesa Verde National Park, Parmley approached the Park administration about possible common interests. The initial conversations which began during the early months of 1992 focused on ways to convert still images into digital formats and make those images available on diskettes. Later the focus expanded to include video clips and sound files which could be distributed on compact disks (CDs). These early conversations along with those that followed provided the foundation for a very active partnership.

Consideration of Park's Needs and Opportunities

The majority of the Partnership's early activities were related to school-based activities. Then, in 1995, Art Hutchinson moved from Mesa Verde to the Superintendency at the National Park Service's Hovenweep National Monument and John Parmley returned to full-time faculty status after seven years service as chair of an academic department. During this same time period, several significant advancements were made in computer technology and the Internet. The time was right to focus on opportunities to use technology to enhance Park missions.

During the months leading up to the events of early 1995, the authors spent considerable time examining the impact of emerging technologies on Parks and related sites. The authors found themselves engulfed in concepts such as the Internet, cyberspace, bits and bytes, chat lines and a host of other relatively new "techno words." They watched with care as Parks developed Web pages and acquired electronic visitors who were able to learn a host of facts about various Park Service locations.

During the summer months of 1995, Hovenweep and Kansas State University (KSU) decided to launch the development of a multi-page Web site to provide additional services to visitors. However, implementing this project was not without substantial problems.

The Expanded Hovenweep Web Site

While many features make Hovenweep an intriguing place to visit, many of these same features became significant "off ramps" from the information super highway. Hovenweep is 41 miles from the nearest town and 12 miles from a telephone line. Thus, it became quite difficult for Hovenweep's staff of two Park Service employees to establish a World Wide Web presence beyond what was being developed centrally by the National Park Service staff. At this point, Kansas State University stepped forward and offered to provide space on an existing Web server as well as the technical expertise to develop and manage the site if Hovenweep would provide the content expertise. Suddenly, the barriers of location, staff time, and round-the-clock management disappeared and the Official Expanded Web Site for Hovenweep National Monument was

launched. This partnership arrangement not only provided special opportunities for Hovenweep, it also provided opportunities for faculty and students on the KSU campus an occasion to have meaningful involvement in a highly unusual activity.

The partners began by identifying and developing images for the Web Site. They subsequently used Adobe Photoshop 3.0 and 4.0 to manipulate images. Adobe PageMill 2.0 was used to develop the HTML programming.

Lessons Learned by the Partners

One of the first lessons learned by the partners related to **design** and subsequent functioning of elements within the Site. It seemed important to have the appearance of the Web Site reflect the look and feel of the cultural artifacts preserved within the Monument. Based on that assumption, specific graphics were identified or developed to help tell the Hovenweep story. The initial plan for the Site included the following features:

- historical information,
- discussion of the various villages within the Monument,
- the location of the Monument,
- other important visitor information items,
- a link to the National Park Service Web Site,
- a Guest Book designed to provide an opportunity for visitor feedback, and
- a center for links to other regional and/or related Web sites.

Specifically, the design for the Web Site not only addressed the subject or primary content of the Monument, but also, reflected that primary content through graphics and the use of such applications as black background to reflect the solitude and sandstone textures on appropriate buttons and images to represent the sandstone blocks used by the early Native Americans who built the villages now preserved within Hovenweep.

With the basic design features in place, the partners began making a number of technological and design modifications. These early modifications involved testing such emerging concepts as a short sound file (800K) from an interview with Superintendent Hutchinson. Other related modifications considered during that initial year included an automated slide show option for visitors with additional interests and modification of several features to increase the overall loading speed of the site. The partners concluded that all modifications needed to be tested on their home computers which accessed the Web Site through local Internet service providers. If an addition or modification uploaded in a reasonable amount of time through typical modems and over telephone lines, they anticipated it would generally load in an acceptable manner for electronic visitors. Thus, uploading speed for all features and the need for balance between inviting graphic design and acceptable uploading speed were additional important lessons.

From the very beginning, the partners believed there was a need to provide a personal touch and interact with electronic visitors. The partners also needed to know what attracted visitors to the Web Site, what features they liked, and what features they found troublesome. One of the initial approaches to meeting these needs became the Hovenweep Guest Book. Electronic visitors were encouraged to provide their name, home location, e-mail address, and submit comments and/or questions. These e-mail responses were then forwarded to Hovenweep and KSU. Responses from electronic visitors supported the partners attention to the basic design concerns previously addressed. One early visitor stated concern when the home page for the Hovenweep Site took longer than 30 seconds to load. Input from electronic visitors became and continues to be an important source of decision making data. The partners had learned another important lesson as they considered the various messages they received through the Web Site. Their electronic visitors welcomed the opportunity for personal interaction and involvement in the Web Site.

Summary of Data provided by Guest Book Registrants

Even though technical problems occurred which kept the Guest Book from functioning from early June through mid September 1997, the peak visitation period, the site has accumulated 87 usable registrations.

Visitor Input. From the information provided by Guest Book registrants, the authors have determined that 53 (61%) of the registrant names were male, 30 (34%) of the registrant names were female, and 4 (5%) of those visitors who registered did not provide a name or the name provided could not be identified specifically as male or female. The partners are concerned about the difference between male and female registrations. They are continuing to examine the Web Site and comments from electronic visitors to determine if certain features attract male visitors more than female visitors.

The partners recognize that the current rate of registration for the Web Site is approximately one registrant out of every 40 visitors (2.5%). Visitor recommendations are viewed as important representations of opinions held by the greater electronic visiting public. However, with what seem to be quite low registration rates, care is always exercised before such recommendations are implemented. At the same time, commitments to the need for visitor input and opportunities for personal interaction continue to be viewed as very important and efforts to remedy the problem with the Guest Book registration feature have corrected the problematic situation. This modification should provide a greater accumulation of valuable data during the 1998 peak visitation period if the visitor registration rate approximates that experienced during 1996 when the Web Site received an average of one registrant for every 14 visitors (7%). The

total visitation hits recorded at the time of this writing exceeds 3600.

Location of Visitors. The 87 Guest Book registrations reached the Hovenweep Web Site from the United States (82 or 94%), Canada (4 or 5%) and Sweden (1 or 1%). Visitors from the United States reached the Web Site from 26 states and the District of Columbia with multiple registrations from Alabama, Arizona, Colorado, California, Georgia, Illinois, Kansas, Massachusetts, Minnesota, Missouri, New Mexico, New York, Pennsylvania, Texas, and Utah.

Comments from Visitors. In addition to demographic data, visitors are provided an opportunity to share *unsolicited comments or experiences* related to their experiences with the Web Site and their on-site experiences while visiting the Monument. They also have the opportunity to ask questions and seek additional information. Among the initial findings were: 70% indicated the information provided through the Web Site was helpful and 42% indicated they wanted additional information about Hovenweep. Twenty percent of the registrations provided supportive comments about the artistic design of the Web Site. Those electronic visitors who indicated they had visited the American Southwest and Hovenweep offered comments about the Web Site capturing some of the look and feel experienced by the on-site visitor.

With two years of experience in providing the Web Site, and 13 months of experience with data collection through the electronic Guest Book, Superintendent Hutchinson has concluded the Web Site saves considerable staff time which would have previously been devoted to writing response letters and has reduced some actual expenses associated with mailing packets of information in response to various traditional mail requests. Through this technology, Park Service staff are able to provide rapid responses to paper and electronic requests while continuing to have personal interactions. They are able to track trends in visitation plans since more visitors are accessing electronic sources of information and using e-mail links to request specific trip planning information. The Hovenweep staff has observed a increasing number of visitors arriving at the Monument with copies of the Web pages which they have printed to help them prepare for their visit.

Application of Lessons from Hovenweep to K-12 Settings and Teacher Education

The partners have continued to analyze data provided by electronic visitors and have the following findings and conclusions which they believe have implications for development of K-12 classroom learning sites as well as teacher education and professional development sites.

Design Issues

The partners considered the design recommendations offered by Milburn and Warner (1997) as they designed the Official Expanded Web Site for Hovenweep. Among the design considerations offered by Milburn and Warner are the following:

- The Web is a landscape view while printed paper is a portrait view.
- People get tired of reading sooner and faster on a computer screen.
- You have restricted control over type and layout.
- The Web is a multimedia experience.
- The Web is a hypermedia experience. (p. 58)

The partners also considered the context issues of Hovenweep as they developed separate pages for the history of Hovenweep, discussion of the various villages within the Hovenweep, recommendations for traveling to Hovenweep, and other important visitor information items. Thus, the technical, artistic, and contextual design considerations were addressed as integrated elements rather than separate issues. The authors recommend developers of Web sites for classroom use or professional development purposes approach development activities in a similar manner.

Personal Interaction and Involvement with the Web Site

The partners continue to be heavily committed to the concept of visitor interaction and involvement in the Hovenweep Web Site. Their commitment is based on a desire to provide meaningful experiences as well as access to information. They suggest we consider strategies used by Park Service professionals as they serve their clientele by making the learning and/or recreational experience as enlightening and enjoyable as possible. It seems that one of their secrets to success has long been their ability to help the visitor **understand and appreciate** the resource base over which they have responsibility. This assistance in enhancing the breadth and depth of understanding is referred to as **interpretation**, a concept that should be examined by K-12 educators as well as those helping to prepare K-12 educators.

With a firm belief that significant learning opportunities and experiences can be provided through uses of technology, the partners examined the work of The National Academy of Sciences and The National Academy of Engineering (1995) in a collaborative work titled, *Reinventing Schools: The Technology Is Now:*

> Children have always been explorers, born with the ability to interact and learn about the world. But children today are growing up in a different world. Those between the ages of 3 and 18-and especially children entering school today-are being hailed as the "Nintendo Generation." They live in a world that is increasingly interactive, communications intensive, and knowledge based. They are standard bearers in the technological revolution, having

never known anything else. Because of their ease in and with the information age, society needs their active involvement and interaction.

The changes going on today create an opportunity and necessity for a transformation in the way our schools function and our children are taught. If we cannot teach our children how to play and work in this world, our children will remain at risk. Education must be based on a model that is appropriate for an information-driven society. We must prepare children for a future of unforeseeable and rapid change. (http://www.nap.edu/readingroom/books/techgap/navigate.cgi)

The initial design of the Hovenweep Web site as well as the partners' recommendations for classroom-based Web sites has been influenced by the works of such authors as Means, Blando, Olson, and Middleton (1993) and Knapp and Glenn (1996). Means, et al. (1993) offer important considerations for using technology in education as they conclude:

The primary motivation for using technologies in education is the belief that they will support superior forms of learning. For this reason, theory and research in learning provide an extremely important source of ideas. Advances in cognitive psychology have sharpened our understanding of the nature of skilled intellectual performance and provide a basis for designing environments conducive to learning. There is now a widespread agreement among educators and psychologists ... that advanced skills of comprehension, reasoning, composition, and experimentation are acquired not through the transmission of facts but through the learner's interaction with content. This constructivist view of learning, with its call for teaching basic skills within authentic contexts (hence more complex problems), for modeling expert thought processes, and for providing for collaboration and external supports to permit students to achieve intellectual accomplishments they could not do on their own, provides the wellspring of ideas for many of this decade's curriculum and instruction reform efforts. (http://www.ed.gov/pubs/EdReformStudies/TechReforms)

Knapp and Glenn (1996) report on the experience of teachers teaching with technology who say they:

- Expect more from their students and expect their students to take more care in preparing their work
- Can present more complex material (more complex ideas)
- Believe students understand more difficult concepts (concepts requiring critical thinking)
- Can meet the needs of individual students better
- Can be more student-centered in their teaching
- Are more open to multiple perspectives on problems
- Are more willing to experiment
- Feel more professional because, among other things, they spend less time dispensing information and more time helping students learn (p. 17)

Finally, the partners want the electronic visitor to have a feeling of involvement and ownership. The Hovenweep Web Site was intended to provide a variety of experiences rather than simply transmit information. Efforts to accomplish this goal led the partners to include a variety of multimedia, provide an opportunity for visitors to receive an "electronic visitor's certificate" which uses cgi technology to insert the visitors name into the certificate graphic, and the recent addition of the "Hovenweep Visitor's Scrapbook" which provides opportunities for individuals who have visited on-site to share their favorite photographs with the world of electronic visitors.

In a classroom setting such involvement and ownership may be accomplished by providing opportunities for students to make contributions to a Web site which supports an area of the curriculum or by providing opportunities for students to design and implement their own Web pages to capture their interpretation of an area of the curriculum. Regardless of the strategy utilized, anything less than meaningful involvement of students will tend to be received as using technology to facilitate traditional teacher-centered learning experiences.

The authors recommend K-12 educators and those involved in preparing classroom teachers consider the recommendations of Singh and Means (1995) as they make decisions about developing classroom-based Web pages and others possible uses of technology:

If our goal is really to provide students with a different kind of education—structured around the provision of challenging tasks that can prepare them for a technology-laden world—the most relevant uses of technology are as tools and communication channels . Giving students experiences in selecting appropriate technology tools and in applying technologies such as word processors, spreadsheets, hypermedia, and network search tools to their work supports the performance of complex, authentic tasks and provides experiences that prepare students for the world outside of school. (http://www.ed.gov/pubs/EdReformStudies/EdTech/)

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Developing Web Sites for Professional Development

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The Internet is currently perceived as a place to disseminate good practice for education and to promote lifelong learning throughout the world. The Society for Information Technology and Teacher Education (SITE) has been in the forefront of these activities with a particular focus on the professional development of teachers.

In 1996, Davis (1996) noted the important role for teachers and teacher educators as participating designers of Superhighways for education and training. The Society for Information Technology and Teacher Education has long been involved in the design, development and use of telecommunications resources to promote teaching and learning. These resources are now being joined on the Internet by a series of new and related Web sites that have particular foci - such as:

- Virtual Telematics Research Centre for Teachers
- Language Teacher Education
- Evaluation and Research
- Courses of Teacher Training

These Internet Web sites offer both similar and contrasting approaches to disseminating useful information for teachers and students and should be of particular interest to the SITE membership and to those who host and contribute to Web sites around the world. Several teacher education sites will be introduced in this overview, including:

- InSITE, the Information Network of the Society for Technology and Teacher Education
- SITE's international section of InSITE
- T3Centrum for teacher training across Europe
- ITTE's planned Virtual Research Centre for teacher education.

InSITE

The evolution of InSITE, from an early text-based Internet resource for teacher educators interested in the use of information technology, to a comprehensive Web site, is described by Robin, Bull, Bull, & Willis (1995) and Boger-Mehal, Rosa, & Nonis (1996). Originally set up as the Teacher Education Internet Server, the TEIS, was a collaborative effort among the Society for Information Technology and Teacher Education, the University of Virginia, and the University of Houston and was originally accessible only via gopher and Telnet Internet resources. With the widespread growth of the World Wide Web, InSITE was transformed into a more accessible Web resource dedicated to exploring ways in which the Internet can be used both to benefit teacher education programs at colleges and universities around the world and to support K-12 staff development technology initiatives. The mission of InSITE is twofold:

1. to serve as an online resource or clearing house that offers both text-based and multimedia materials related to the integration of technology in teacher education, including staff development; and
2. to explore how educators from various content areas and at various locations can collaborate over the Internet to discuss important issues and develop innovative ways to utilize technology in the field of teacher education and staff development.

InSITE continues to evolve as the use of educational telecommunications technologies grows and teacher education programs seek new ways to integrate these technologies into their training.

InSITE International

InSITE International has been developed specifically as the international section of InSITE. It seeks to provide a collection of materials, online discussions and links to other teacher education services and resources outside North America. It's aim is also to promote international collaboration between teacher educators and the classes with which they work, both inside and outside the USA and encourage and support teachers, teacher educators, and administrators in the use of Information Technology to meet their needs.

T3Centrum

The T3 Centrum is also a Web site for teacher education. It has been created as a central resource to support the European project "Telematics for Teacher Training" (T3).

The project is creating courses for the training of teachers through information and communication technologies, so the T3Centrum aims to enhance collaboration, teacher education courses, and dissemination. Although the project ends in December, 1998, it is hoped that the collaboration and support will continue and spread across Europe and the world. Already the T3Centrum contains resources and courses for teachers of mathematics, science, language, and technology and for librarians working with teacher trainers.

Virtual Research Centre

One of the plans for expansion to support teacher education on the Internet is for a Virtual Research Centre on the Internet. In autumn 1997, the UK Association for Information Technology in Teacher Education held its third Research Conference, in memory of Brent Robinson in Cambridge. The Association has agreed that these presentations may be placed on the Web to create a forum and resource to promote research and evaluation of IT in education. This may be linked with the SITE monograph edited by Waxman and Bright (1993), the two international journals in the field, the Journal of Information Technology for Teacher Education and the Journal of Technology and Teacher Education, as well as a proposed book.

In Europe, a very creative site has been developed by Ronald Soetaert and Guy van Belle for language teachers. The site uses Robinson Crusoe in its many forms to challenge teachers of many languages (Soetaert, Top, & van Belle, 1995). Ronald and Guy are now developing a major site for language teachers across Europe in conjunction with the Telematics for Teacher Training project's T3Centrum mentioned above.

Michelle Selinger has developed expertise and research into online learning by student teachers using First Class computer conferencing that was implemented by the UK Open University's course for students teachers (Selinger, 1996). Michelle is now implementing a First Class Computer Conference across the UK form her post in the University of Warwick where she leads a course preparing teachers of IT.

Summary

It is obvious that the Internet and the World Wide Web offer valuable resources for teacher education programs, preservice teachers, practising teachers, and indeed, anyone interested in gaining knowledge related to teaching and learning. The "World Wide" nature of the Web is also obvious as more and more countries are understanding and promoting the power of the Internet as an educational force. We are certain that newer and better methods for world wide collaboration and interaction will be developed, tried, and evaluated and that these methods will lead to the further enhancement of teacher education with information and communication technologies.

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A Model of Internet Usage for Course Delivery

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In the world of limited funding, where teachers' needs always seem beyond their resources, the Internet is being used to expand educational opportunity. The Internet is not specifically designed to meet the needs of teachers or of education. The Internet is a network of networks, and it is up to educators to create educational opportunity and bring the education to the Internet. Teachers are quickly realizing that the Internet is a tool with unlimited possibilities for supplementing managing and delivering whole courses.

To improve teacher training, the following model was developed to summarize and categorize teachers' levels of current and future Internet usage in teaching. Educators have embraced the use of technology in education to better "challenge the bright and more effectively engage the less able" (T.H.E. Journal, 1997, p. 8). People are gaining access to the Internet at a record pace. The Department of Education (National Center for Educational Statistics, 1996), ran a survey that showed over 50% of U.S. schools have access to the Internet. That figure rose 15% between 1994 and 1995, and the Clinton Administration has urged a national commitment to have all classrooms and libraries connected to the Internet by the year 2000 (Grabe & Grabe, 1998). This model of Internet usage will hopefully better prepare teacher educators to help inservice teachers learn to use the Internet to support their courses.

Three levels are determined by how the Internet is used educationally by teachers. Grabe & Grabe (1998) indicate that a theme of technology use in the classroom creates the need for students to have an active role in order to benefit from that technology. Traditionally, an active learner may manipulate information to help in building their own personal understanding of content, but for the Internet to be helpful, its use has to be structured and its presentation integrated for specific content. Simply exposing students to information does not ensure that learning will occur. At all three levels of Internet inclusion, the student is subject to an environment whose value to the course is completely determined by the teacher. And so, this process requires both active students and active teachers.

This three-level model is derived from the principles of two mutually exclusive instructional approaches: explicit and implicit teaching. These two instructional approaches account for the most common teaching practices (Mercer, Lane, Jordan, Allsopp, & Eisele, 1996). Level One Internet use includes an explicit approach exclusively and Levels Two and Three use an implicit approach. The transition from Level One to Level Three is based on the increase of student interaction with the Internet and course content. Both instructional approaches are "needed to address the needs of students in a diverse classroom" (Mercer & Mercer, 1998, p.142). It should be noted that Level One and Level Two are intended as supplementary to traditional course structures and not intended to provide a complete course. Level Three may include entire courses offered on the Internet. Everything from electronic mail between teachers and students to interactive Web pages for full course delivery and beyond is described in terms of this three-part model.

Level One

Level One use of the Internet focuses on supporting a traditional classroom setting in two areas: management and instruction. "Management" ranges from course support material (syllabi, reduction of paper copies, etc.). "Instruction" encompasses the direct interaction between content (from the teacher) and students.

Typically, the management of a course is a tedious and cumbersome process. The mountain of paperwork each teacher is under continues to grow and takes away valuable instructional planning time. This process is also difficult for the student who follows this paper trail. One option for using the Internet for management is to create a course Web site that can automate much of the process. This site can contain almost anything that an instructor deems important to the course. The result is increased efficiency. The student can access information from anywhere and at anytime by simply getting online. This access allows the student to track changes or updates and better follow the flow of the course.

Level One involves explicit instruction where the teacher is more directly involved. The teacher will guide the student to the information on the Internet. Discovery by the student will be controlled by the teacher and by the

structure of the content on the Internet. This requires that a teacher's preparation include scouting the Internet to find information that relates specifically to the content. Davies (1997) has indicated that advance planning for Internet use is important.

There is no creating or shaping of the Internet at this level. The teacher simply maps an activity and makes use of the already existing Internet. Students are exposed to skills and concepts in a clear and direct fashion in order to promote mastery. The approach is one of explicit teaching where the teacher and the Internet serve as the providers of knowledge. This level of use does not require that the student have any knowledge of computers beyond that of a "point and click" ability because the teacher takes the student to the information.

The Internet is analogous to a library where the teacher takes the student into the library and directly to a book (Level One). The Internet also serves as a provider of knowledge because the content on the Internet is authored by someone other than the teacher. Just like reading a book, viewing the Internet leaves the viewer subject to structure and content choices of that author. If the teacher assumes the students have some Internet access, the teacher can create a list of specific Web addresses (URLs, or uniform resource locators) to visit and specific things for the student to do. This is much like a directed worksheet where the Internet is the medium. In the library analogy, this would involve identifying the call numbers for specific books and using these numbers to locate the books. Using the card catalog is a system that is a bit more complex and the activity of using the card catalog moves us beyond Level One use and into Level Two.

E-mail can be used for students to contact the teacher and other students in the same course or around the world. The introduction of electronic mail to this level marks a change in the type of interaction the student is having with the Internet, but when this interaction takes the form of communication at a non-instructional level, it remains a Level One use of the Internet.

Level Two

Teachers' usage of the Internet reaches Level Two when they use the Internet in the actual delivery of instruction (as compared to merely supporting instruction with additional content). The teacher can use the Internet to deliver course activities (assignments, collaborations, etc.) to students that have traditionally been provided on paper or a chalk board. At Level Two, this is done with an implicit approach to instruction. This means that the teacher becomes a facilitator of knowledge and creates situations where students can discover the content and create their own meanings. This is to say that the learning is somewhat self-regulated and the teacher assistance is more indirect. Teachers can use the Internet in two ways to accomplish this. First, they can have students make use of Internet tools to explore content and second, teachers can create actual lessons on the Internet.

Teachers can provide assignments directing students to use a Web browser to explore specific Web sites and e-mail to learn course content. The browser is equipped with a "bookmark" tool which gives students the ability to keep track of relevant places as they move through the Internet. There are also search engines that improve one's efficiency in moving from place to place on the Internet. Chat rooms are available for online collaborations with other students, the teacher, or possibly an expert in a certain content area.

Some students are likely to have difficulty using these tools at first. Teachers may begin by modeling the use of these tools for the students to observe. There is a good compromise between teacher modeling and a completely independent student usage. The teacher could create a simple Web page with specific instructions of tool use, URLs, or even links to existing Web sites. This is designed to improve the students' ability to explore rather than teach content. The more the students use this technology, the more proficient they will become. All that is left is for the teachers to use their imagination in creating assignments and activities (i.e., searching for resources, collaborations, etc.).

Level Two e-mail usage finds students submitting assignments as attachments or directly in the message, receiving data and answering questions through the Internet. So, Level Two accounts for e-mail usage expanded to involve instructional issues beyond the simple forms of casual communication. Grabe & Grabe (1998, p. 14) provide a list of e-mail project categories from Harris (1995) to help structure instructional activities. They are listed and described here to help generate ideas for Level Two usage of the Internet:

- Interpersonal Exchanges - "talk" among individuals, between an individual and a group, and among groups. This can be a Level Two usage by making the "talk" questions about content.
- Key Pals - unstructured exchange among individuals or groups; e.g., exchanges to develop cultural awareness or language skills.
- Global Classrooms - study of a common topic and exchange of accounts of what has been learned; e.g., themes in fairy tales.
- Electronic Appearances - e-mail or chat interaction with a guest, perhaps after some preparation; e.g., local engineer responds to questions from students in a physics class.
- Electronic Mentoring - ongoing interaction between expert and student on a specific topic; e.g., college education majors offering middle school students advice on class projects.

- Impersonations - participants interacting "in character"; e.g., correspondence with graduate student impersonating Benjamin Franklin.
- Information Collections - working together to collect and compile information provided by participants.
- Information Exchanges - accumulation of information on some theme; e.g., recycling practices.
- Electronic Publishing - publication of documents based on submission by group members.
- Tele-Field trips - shared observations made during field trips.
- Pooled Data Analysis - data collection from multiple sites, combined for analysis; e.g., cost comparison of gasoline.
- Information Searches - problem solving based on clues and reference sources; e.g., identifying state landmarks or cities in response to a progression of clues.
- Electronic Process Writing - posting written work for critiques before revisions; e.g., composition students commenting on classmates' papers.
- Sequential Creations - working on sequential components of an expressive piece; e.g., adding a stanza to a poem.

The Internet is a tool that has no inherent or required mode of application. The role of this technology in education is the responsibility of the teacher. Teachers can provide entire lessons on Web pages. This can be done with descriptions of assignments, explanations, concepts, examples, and illustrations. This is where a teachers' Web design skills or Web support personnel become important factors in quality and feasibility of creating lessons on the Web.

The teacher needs to become familiar with the world of Web-page construction. It is fair to say that almost anything a teacher would like to include in a lesson is possible, and there are so many Web-page editors available today that the process can be fairly automated. In fact, lots of software that teachers may already use in preparing lessons provides the option of being saved in an HTML (hypertext markup language), Web-ready format. This means that many teachers may already have much of the ground work completed for learning to prepare their own Web pages. To make more intricate Web pages and take full advantage of the tools available, it can be as simple as choosing a Web-page composer and learning it. The Internet would be a good place to search for one because many are available as freeware or shareware. This would allow the beginner to download one for free or for a small registration fee. Learning Web construction may be viewed as programming in hypermedia, usually with a very user-friendly word processor-style editor or a relatively simple authoring language, such as those found with Toolbook or HyperCard.

Level Three

This model has first accounted for increasing student interaction with the Internet and course content. The second focus has dealt with educational philosophy (explicit/implicit roles). Level Three is an extension of the same phenomenon where students are even more dependent on the Internet for course content. Level Three finds complete courses offered and received through the Internet where teachers and students interact with each other and the material exclusively via technology. Level Three involves a greater technical function of Internet tools for interactive lessons, online assessment, real-time collaboration, and more.

The length of a Web-based course (WBC) tends to take twice as long as a normal course. Generally speaking, the time for development planning takes longer as well. One must make many pedagogical decisions about the course. It seems that the most organized teacher (regarding lesson content) will be able to make the easiest transition to a complete WBC. One suggestion is that teachers develop one WBC lesson or unit at a time to make the transition more gradual. This model exemplifies the details of a gradual transition.

At this level, having some form of technical support can be a very crucial element in the success of a WBC. It is important to note that e-mail and e-mail attachments will, most likely, become an important part of your course. This will be for communication, assignments, projects, assessment, etc. Look at any branch of the course and e-mail may be seen as having a role. One problem to anticipate is the finicky nature of file conversion that is inherent in e-mail interaction. There are ways around most of the problems that might be encountered, and most of those are probably not too complicated. Consult your technical support department.

At this point, there are no requirements or essential features that must be included for a WBC. One should still consider issues of course quality, from the perspective of the student, when developing the course. One quality issue is whether or not something more than a mere tutorial is being developed. To ensure that this happens, it seems important to focus on the interactivity of the course. Discussions are a nice way to do this. Many use asynchronous discussions via e-mail, which has the advantage of convenience. Another way to do this is through online discussions (chat sessions) done in real-time. Scheduled and assigned by the teacher, he or she can then directly participate and thus help drive the discussion. Many teachers have said that this process was invaluable. It even gives teachers the opportunity to get to know the students. Verifying the identity of the student can be a concern. Is the person taking the test the same person as the one doing the homework or participating in the discussions? The chat

sessions help the teachers identify and learn the students better.

Another quality concern is whether or not the technology used in the WBC is of high or low technology? It seems fair to say that a teacher wants as many people as possible to have access to their course. That prerequisite dictates that the course should be developed closer to the low end of technology since many people are always playing "catch up." This will surely be a point of constant debate and cause the WBC designer to continually work on revising the course.

Summary

From the teacher whose goal is to increase efficiency, to the teacher concerned with designing a Web-based course, the three-level model structures various types of instructional use. Recognizing that such an organizational system includes a large degree of overlap, all levels include teachers using the Internet to improve instruction. Teachers make use of the Internet incrementally through the use of this model by progressing through the three levels. It is suggested that if the ultimate goal is to develop a WBC (time permitting), that it be done in a modularized approach, one unit at a time.

To help instructors focus on planning a list of ten ideas/issues for the development of a WBC include (in no particular order):

- Identity of student & passwording
- Time - course planning, course length
- Online discussions
- Technical support
- Assignments & activities
- Content
- Student access
- Copyright issues
- Technology - hardware & software
- Testing and assessment

Understanding how and at what levels the Internet may be implemented into education is a first step that will better enable us to meet specifically identified goals and objectives. As teachers are trained in the use of telecommunications and the Internet, this model can direct their study from beginner level through becoming independent distance educators.

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Online Survey, Enrollment, and Examination: Special Internet Applications in Teacher Education

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In a popular New Yorker cartoon, a dog sitting in front of a computer says to another dog: "On the Internet, no one knows you're a dog." It is true, no one will be recognized by race, nationality, gender, or disability while surfing on the net. The Holmes Group (1993) called attention to the importance of technologically rich field sites for students to practice their teaching. Preservice teachers must see how technology is used in school settings and have opportunities to practice teaching using these technologies. The Internet provides rich information for teaching as well as current research on effective curriculum and teaching strategies. Students can participate in electronic discussion forums that give them the opportunity to provide critiques and to share URLs identified on the Web.

Romiszowski (1994) reports that e-mail is more interactive than most other computer-based products. Student teachers view posted messages from other students, post their own messages, and respond to messages from others. Student teachers communicate with other students and view personal home pages and are able to maintain communication with university supervisors. They also apply technology skills as they search for sources for teaching strategies and lesson plans. While many students complete projects at their assigned school site, others use personal Internet applications or services in libraries or other settings. Class information, announcements, and schedules are posted with relevant information regarding meetings or deadlines for projects. Direct links are provided for students to preview teaching materials on the net. As student teachers move through the semester, they work through Russell's (1996) six categories of technology: awareness, learning the process, understanding and application of the process, familiarity and confidence, adaptation to the contexts, and creative application to new contexts. With the use of the Internet, parents, students, and teachers from all over the world can respond, communicate, and exchange ideas, post questions for discussions, create project Web pages, and even conduct surveys, enrollment, and examinations online.

Online Survey, Enrollment and Examination

In teacher education, staff and faculty often need to conduct surveys, provide enrollment procedures, and give student examinations in one form or another. Prior to the advent of the Internet and the World Wide Web, survey questions, enrollment material, and examinations were usually printed on paper and then sent to students via postal mail or handed to them in person. The whole process is somewhat rigid, inconvenient and time consuming. With current Internet technology, conducting surveys and enrollment online has become feasible and desirable. Allowing students to take examinations online is also technically possible, although some difficulties remain in terms of automatic grading of essay-type questions. The grading can be entirely automatic for single-choice or multiple-choice problems and for some simple answers.

Technically, the design and implementation of these three applications on the Internet all have similar features. Each of the applications involves some form of data collection. The main difference lies only in data processing. Four phases are in order: problem design, Web page design, implementation, and testing. During the problem design phase, the types of questions to be conducted should be determined, whether to use single choice, multiple choice, short answer, or long text. During the Web page design phase, the appearance of the forms should be addressed. The forms to be filled out by the students should be user-friendly, well organized, and suitably sized. The implementation phase involves the actual writing of the Web pages including forms and computer scripts for processing the data to be collected from the Web. Testing, though tedious, is an important step before the Web pages are posted on the Internet. In the following, we present a project that involves the design and implementation of an enrollment system for student teachers to register online. This system is already in use by the Office of Professional Education Services at Emporia State University. The techniques for developing online survey and online examination systems are similar

to those involved in this project and, therefore, will be omitted.

An Online Enrollment System

Project Description

The Teachers College at Emporia State University in Kansas is now utilizing Web technology for automating the application procedure for student teaching. In previous semesters, students completed a five-page application using a typewriter or word processor. Students now demonstrate their technology skills through an electronic application process. The program can be accessed through any Netscape or Microsoft Internet Explorer Web browser. By completing an "Intent to Student Teach" form that includes the social security number, students gain access to the Internet program. Students enter information such as the list of courses taken, the requested districts for placement, a letter of introduction, and other personal information needed to make the placement. This process gives students another opportunity to apply technology skills and at the same time automates the application process. Students can apply at any time and at any place where there is an Internet connection, whether that be a university lab, wired dorm, or home computer.

Background Knowledge

Before describing the enrollment system, we shall briefly explain the general concepts and some of the key terms that are important for understanding the process involved in this project. Refer to Buhle, et al. (1996) and Stanek (1996) for more details.

- **Client-Server Model**
  Web technology is based on the client-server model in which the client makes requests to the intended server for services and the server provides such services for the requesting client. In our case, the client simply refers to the browser used by the applicant to access the Web pages and/or to enter the data for registration, and the server refers to the program that serves the Web pages and/or accepts the submitted data.
- **HyperText Markup Language (HTML)**
  Based on a subset of the Standard Generalized Markup Language (SGML), HTML is a specific language used to create and access resources on the Web. It uses tags and commands to format a document. Tags are also used to indicate functionality and to define services.
- **HyperText Transfer Protocol (HTTP)**
  HTTP is a set of rules that govern the communication between a Web browser and a Web server. It is regarded as the official language of the Web. An HTTP server, or a Web server, refers to a program that serves Web pages on a computer.
- **Common Gateway Interface (CGI)**
  CGI is the interface between an HTTP server and the resources of the server's host computer. A CGI script refers to a program written in some suitable computer language such as Perl, Rexx, C, or Java, that accepts data from the Web server, performs necessary processing, and sends output to the server which will then report the results back to the client. The simplest client-server model for a Web client requesting a Web page from an HTTP server is shown in Figure 1, where no CGI script is involved in the process.

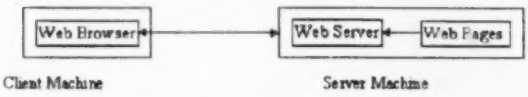

Figure 1. The basic Web client-server model.

For an online enrollment system to work, this simple model is not enough since one or more CGI scripts are required. Figure 2 shows a more general model that involves the interaction among the Web browser, HTTP server, and CGI scripts. With this background knowledge in mind, the design considerations and implementation strategies of the online enrollment system will be presented.

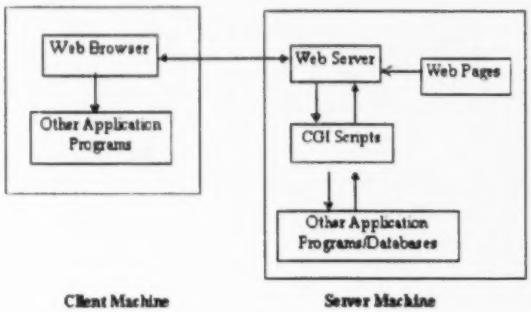

Figure 2. A more interactive Web client-server model.

Design Considerations

In designing such a system, we had three main requirements to consider. First, the system should allow student teachers to use a Web browser to enter and submit application data and personal information from remote computers connected on the Internet. Second, in addition to this basic capability, which is required in any online enrollment system, it should also allow the applicants to update their information at any later time after registration. This latter capability is especially convenient and useful since it not only enhances flexibility but adds modifiability by the applicants, encouraging them to update their data at their earliest convenience. Third, the system should allow only eligible students to register and should minimize the involvement of staff or personnel for maintenance.

Implementation Strategies

Our implementation consists of following three parts: The HTML document, 2) an identification database, and 3)

CGI scripts. The HTML document is created using the Hyper Text Markup Language and is grouped into three folders. The first folder stores the identification Web pages. The second folder stores blank application forms which include the applicant's demographic information sheet, teaching assignment request data, academic activities/ experience, and statement of introduction. These two folders are common for all applicants. The third folder is initially empty and will be used by one of the scripts to create individual subfolders, one for each applicant. The data submitted by the applicants are processed using CGI scripts written in Perl. Two different scripts are implemented: one for identifying the applicants and for creating individual folders, the other for storing and updating the submitted data. The identification database is used by the script to identify whether the applicant is eligible for enrollment or not. This database should be and is the only part that need be maintained by the authorized personnel for adding and removing entries.

Application Procedure

The application of this system is divided into two stages: identification and enrollment. During the identification stage, an applicant is asked to provide his/her name and a password which are then checked against the identification database by the first script to determine if the applicant is eligible for enrollment. This stage is crucial since the system is to be used only for student teachers. Once eligibility is successfully determined, this same script also creates a private folder consisting of HTML files for this specific applicant. The system then enters the enrollment stage and prompts the applicant with application forms, one by one, asking for more information. These forms are designed as separate pages so as not to overwhelm the applicant with input. In other words, the second form will be available only after the first form has been submitted, the third form will be available only after the 2nd form has been submitted, and so on. Whenever a form is submitted, the HTTP server invokes the second CGI script to process the submitted data. Since the system is designed to allow the applicant to update information at any later time, the data submitted by the applicant are automatically entered into the form fields of the Web pages in the private subfolder to make them available to the applicant the next time the same pages are revisited. It is important to note that the subfolder belonging to an applicant is accessible only to that particular applicant.

Conclusion

According to Andres (1993), there are an estimated 50,000 teachers worldwide using the Internet. In the US, Internet access for schools ranges from 44% in Mississippi to 92% in Vermont, while many states, such as Kansas, hover around the national average of 70% (Education Week, 1997). The numbers are increasing on a yearly basis as President Clinton proposes to have all schools connected to the Internet by the year 2000. The continued growth of educational technology use in U.S. schools has prompted interest in strengthening technology literacy in teacher preparation programs. This interest is spearheaded by The National Council for the Accreditation of Teacher Education technology standards for prospective teachers that were developed in collaboration with the International Society for Technology and Education (ISTE:1992, NCATE:1994).

The importance of technology in teacher education was strengthened in recent months by the release of the 1997 NCATE Task Force on Technology and Teacher Education report, "Technology and the New Professional Teacher: Preparing for the 21st Century Classroom." The task force concluded that teachers must teach beyond the textbooks through applications such as Web technology to prepare students for an information-based society (Cooper, 1997). Studies of effective technology in teacher education emphasize that teacher education students must have opportunities to acquire understanding, skill, and confidence as they learn these new technologies (Niederhauser, 1996) and conventional methods of lectures and discussions are not sufficient for learning skills needed to implement educational technology (Dell & Disdier, 1994). Cognitive capacity for learning is greater when students are able to apply new knowledge to teaching situations (Watkins & Marsick, 1995). Teacher education must find ways to apply new technologies to classroom settings (Mckinzie & Clay, 1995). Teacher education programs can use Web technology in various ways, including automated procedures that make existing organizations more efficient. The Web can also be used to support information technologies that expand knowledge and understanding (Zuboff, 1988).

The next goal of our project is to develop an electronic data interchange system where information from files can be merged and faculty can approve applications through a form-based system rather than by manual approval. It is also our goal to allow present and past cooperating teachers and other student teachers across the state and nation to participate in the bulletin board component.

If teacher preparation programs are to produce teachers who are capable of using new computer technologies, preservice programs must prepare them. Only through extensive preservice applications will teachers acquire the understandings, skills, and confidence they need to use technology in their classrooms and prepare their students for an information-based society.

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E-Mail: Communication of the Future?

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Technology has been infiltrating our lives for years, but today technology is an integral and often necessary part of our lives, and many people cannot seem to function without it. Technology presents us with many new opportunities, which have potential advantages and disadvantages for the world and societies that employ technology. As technology has become a more integral part of our lives, so does it bring about changes in the humans that use the technology and the interactions that occur between individuals. The use of technology to communicate has brought about many advances in human communications, such as more frequent contacts, quicker delivery, and multiple contacts. However, while there are many advantages to using multimedia messaging (e-mail, faxes, video and data exchange), what are the costs that come along with its use? Today, multimedia messaging is becoming a natural part of business, education and interpersonal relationships. This form of communication was not part of the natural repartee of individuals in the past, individuals focused on face-to-face interaction when dealing with each other. What is the impact of using electronic messaging to communicate?

As technology continues to influence our communication so does it affect our very lives. This article addresses issues related to one particular type of electronic messaging, namely e-mail. E-mail is the practice of sending information from one computer user directly to other computer users, allowing nearly instantaneous transmission of messages, to anyone or any number of people with personal computers connected to the Internet or mainframe computers. E-mail messages may be sent around the globe, to the person in the office across the hall, or to the desk next to the one sending the message. To use e-mail, all an individual basically needs is a computer and the ability to connect to the Internet. Once these two basic requirements are met the skills needed to use this new technology are extremely easy to learn and master. They can even be performed by many children. The ability to e-mail a vast amount of people around the world almost instantaneously is due to the development of the Internet.

The Internet was originally devised as a way of linking a few university and defense laboratories in the 1960s, but has grown into a global network, currently connecting between 30 and 40 million people. It is estimated that up to 160 million people will be connected by the year 2000 (Weil & Rosen, 1997). The Internet is currently an international network linking hundreds of smaller computer networks in North America, Europe and Asia. Through the use of the Internet, computer users can connect and communicate with a variety of computers and their services with little effort and expense. Three of the main services currently provided by the Internet are: remote login, allowing an individual to log onto remote computers; file transfer, moving or sending files from one computer to another; and electronic mail. The use of e-mail through the Internet appears to be one of the fastest growing forms of communication.

Currently, little research has focused on the impact of electronic messaging, especially e-mail on the lives of individuals. In the recent past, as little as five years ago, many would state that e-mail only impacts a small portion of the population and thus was not worthy of investigation. However, with the rapid increase in the use of technology, the growth of the Internet, computer accessibility and ease of use, this may no longer be the case. The impact of electronic messaging (e-mail) on the lives of individuals should be explored to help understand the positives as well as the negatives of e-mail use. This is quickly becoming evident as such mainstream institutions as *TIME* magazine documented the explosive growth of e-mail. From 1994 to 1996, the number of e-mail messages has swollen from 776 billion to 2.6 trillion, and is expected to top 6.6 trillion by the year 2000 (Gwynne & Dickerson, 1997). Additionally, the *N.Y. Times* recently reported on the changing of parental roles as technology increasing infiltrates the family at an ever increasing rate (Wire Reports, N.Y. Times, 1997). Taking these trends into consideration it becomes obvious that e-mail is proliferating at an astonishing rate and that we can no longer ignore its impact on society, families and the individuals in that society.

E-mail has become a natural part of many individuals lives, with some considering it a blessing, while others crediting it with creating a great deal of problems (Gwynne & Dickerson, 1997; Young, 1996; Parks & Floyd, 1996).

Before we can discuss the problems inherent in using e-mail or relying on e-mail as the only form of communication, it is necessary to outline how e-mail is currently being used in the world and how it may be employed in the future. First, e-mail is being employed in all areas of society due to the speed, ease of use, lack of effort needed to seek the receiver of the message and the cost. E-mail is also one of the few forms of communication where a single message can easily be distributed to a multitude of recipients. E-mail may also be viewed as a more efficient form of communication, where individuals do not have to seek out the receiver of the message, just send it to their e-mail address. However, just sending an e-mail to an individual does not guarantee that the message was received or that the person will respond to the message.

Currently, e-mail appears to serve two primary purposes in the world and society. First, e-mail is being used as a form of communication that allows individuals, no matter where they are located, to communicate with each other on a regular basis at a low cost. Second, is the use of e-mail to advertise and sell goods and services to individuals. Due to the ever-changing nature of technology and society, how e-mail may be used in the future is difficult to tell, but several possibilities do seem to emerge. E-mail will continue to grow as a low cost communication form that will link not only people in one society, but will lead to the connection of multiple societies. This linkage of multiple societies may eventually lead to a blurring of the distinction between societies and individuals of the world. It is possible that through the use of e-mail and other technologies (language translators) a new world society could emerge through the linking of societies and individuals within those societies. E-mail will more than likely continue to grow as a business tool, not only to operate a single company, but to link several companies, all for the purpose of becoming more efficient and containing costs. In the educational realm, e-mail may become the mainstay of disseminating information to students and the primary form of communication between faculty and students. Finally, e-mail and it's various forms may replace the telephone as the primary mode of communication between people who are physically separated.

In the use of electronic mail as an instructional aid, e-mail may provide students with greater access to faculty and peers, with the Internet providing access to a wider array of educational resources for students and faculty. Additionally, faculty may provide notes and materials to students through e-mail, allowing students to access this information at any time, for as long as the information is needed. This is in contrast to having only the notes that a student may take, material handed out in class, office hours and class time with a faculty member. Trapp, Hammond and Bray (1996) note that electronic messaging and the Internet can be used to foster independent learning activities that cannot be undertaken in a traditional course. D'Souza (1991) conducted research that showed that students using e-mail as a communication aid scored significantly higher than students using a more traditional mode of class information and communication modes. Tella (1992) found that with the introduction of communication networks and e-mail into the classroom, learning became more autonomous, small group work increased, and teachers became co-learners with students. Finally, observational data concerning 700 undergraduate students' e-mail messages, showed that less than 50% of the messages addressed work-related concerns. For the most part, the majority of the e-mail messages served a purely social function with roughly 25% of the messages containing intimate content (McCormick & McCormick, 1992).

Although there are many advantages to using e-mail several disadvantages are inherent in the use of this technology. First, e-mail is a new mass media form, in which messages can come from a wide variety of individuals and sources, with little or no centralized control (Rafaeli & LaRose, 1993). This new form of communication blurs the boundaries between interpersonal and mass communication, raising new and exciting opportunities and potential risks for the way individuals relate to one another in the world (Lea & Spears, 1995).

Two popular views have been posited about communication and relationships that develop through the use of electronic media, especially e-mail. One view portrays relationships that develop through the use of electronic media as shallow, impersonal, and often hostile, with only an illusion of a sense of community (Berry, 1993; Stoll, 1995). The other view posits that electronic-mediated communication reduces the obstacles of physical locality, creates new, but genuine, personal relationships and communities (Pool, 1983).

Early research focused on the differences between small groups who communicated either face-to-face (FtF) or through computer-mediated communication (CMC). Findings have consistently pointed to the social disadvantages of CMC, positing that highly developed, positive personal relationships should rarely occur through the use of electronic media (Parks & Floyd, 1996). Culnan and Markus (1987) state that the differences that are observed can most often be explained by observing that many social cues are not possible through the use of e-mail and other electronic media. E-mail does not allow the receiver to focus on or perceive the physical context and nonverbal cues, such as vocal quality and tone, body posture and facial expressions that may be important to interpreting the actual meaning of the message. Thus, CMC would appear to have less information richness then FtF (Kiesler, Siegal, & McGuire, 1984) which may lead to a great deal of miscommunication. This in turn may lead to difficulty in developing personally meaningful relationships through

the use of e-mail and other forms of electronic media. Walther, Anderson, and Park (1994) pointed out that CMC is able to carry many aural and visual cues (included in the text of a message), but that they are restricted by the form of communication. The important point is not that personal and relational information cannot be communicated with CMC (e-mail), but rather that it may take longer to do so.

As research has moved from the laboratory to the field, studies have consistently shown the interpersonal side of CMC (e-mail). Users of CMC have reported on a consistent basis that they develop and maintain relationships, socialize, and receive emotional support via e-mail (McCormick & McCormick, 1992). Further evidence for this development and maintenance of personal relationships can be found in the popular press and some scholarly reports (Bock, 1994; Wilkins, 1991).

Although research appears to be mixed or inconsistent at the current time, the authors feel that e-mail communication and other forms of electronic media with their inherent shortcomings may lead to a variety of problems. Before we leap into this new form of communication and give up the more traditional face to face communication, the impact of these new forms of communication on humans and their interactions need to be examined. First, to develop a meaningful relationship, several prerequisite basic communication skills are required. These include the ability to vocally communicate, decipher the emotional content of messages and perceive and interpret nonverbal behaviors and cues. If individuals grow and develop in an age and society that is dominated by e-mail and other forms of electronic communication, individuals may not have the opportunities to develop and practice the necessary prerequisite skills to develop positive meaningful relationships later in life. This may already have become the case in many families. Several popular press reports (i.e., Wire Reports, NY Times, 1997) noted that children of today are part of the "techno generation." An ever-increasing number of children have their own phone line, access to e-mail, chat rooms and the Internet. It has been estimated that the number of households that have access to e-mail will double by the year 2000. This change in communication and the patterns of behavior associated with it has lead to long-accepted family rules being challenged or twisted in new directions (Wire Reports, NY Times, 1997).

E-mail changes the need to see or interact with others on a personal level, as communication through an electronic medium can happen more regularly and frequently, decreasing the need for personal interaction between individuals. Many medical and psychological experts agree that one of the potentially most disturbing trends with the technology of today (e-mail and Internet use) is that it is addictive (Wire Reports, NY Times, 1997; Young, 1996). The development of the addiction leads many people to spend hours interacting with technology and other individuals through the use of technology, and not interacting with families and friends on a personal level. Young (1996) reported a case of a 43-year-old homemaker who abused the Internet, resulting in significant impairment in her family life. The authors contend that relying primarily on e-mail and other forms of electronic media for communication may lead children and others to not develop and maintain the prerequisite social skills needed to establish and maintain long-lasting meaningful relationships with other individuals. Clearly, further research is needed into how e-mail and other forms of electronic media, as well as technology in general will impact the development of individuals in a society.

A second major concern deals with the use of e-mail in college campus communities. If we view the college experience as an extension of the socialization process that was started in childhood, and continued in secondary education, e-mail use may have some deleterious effects. If students primarily rely on e-mail to communicate with peers and faculty, instead of face-to-face communication, they may not practice or even develop the social skills necessary to establish and maintain long-lasting personal relationships. College is a time for students to take many of the skills that were learned and practiced under parental supervision and for the first time try them out in an environment totally independent from their parents and family. This may even become a bigger problem if children were raised in a technology-rich family environment and never developed socialization skills. These individuals entering college are suddenly thrust into an environment where those skills would be needed to develop relationships with roommates, peers and faculty members. For example, many students who attend college live in dormitories and need to be able to communicate face-to-face and develop relationships quickly with roommates, hall mates and others that reside in the dorm if they are to thrive in these new surroundings. Secondly, due to the amount of time that may be needed to eventually develop relationships through e-mail, students may not develop relationships quickly enough in this new environment to provide the social support needed to help with the adjustment to college life.

Another possible problem that may emerge due to the use of e-mail is that college students will still be tied to their family of origin at a level that does not allow them to initially test their independence and later to become fully independent. Instead of making decisions for themselves, e-mail would allow college students to communicate with family members on a daily basis, thus allowing the student to be dependent on the family for guiding or making decisions for the student. In short, e-mail may interfere with the process of individuation that occurs as children leave home and establish themselves in society and the world.

Finally, the third area that we would like to address is the use of e-mail in the classroom. Although, there are many advantages to using e-mail in the classroom, and some results have been promising, there may be some unwanted consequences that need to be considered. First, messages sent by a faulty member to a student may not be received, or if received, may not be read or acknowledge by the student. This may lead to a variety of difficulties in class management. For example, a faulty member may send a message on Monday requesting a student complete an assignment or reading for class on Wednesday. The student does not check e-mail message until Wednesday just before class and thus has no time to complete the assignment before class. Secondly, by decreasing the exposure time to faculty members, through the use of e-mail, we may be decreasing the time that students are exposed to appropriate professional role models. Thirdly, by using e-mail to communicate with students we may be inadvertently blocking or delaying the development of mentor relationships between faculty members and students that have been posited to be important for the development of competent professionals

Clearly, we have not yet fully realized the potential advantages and disadvantages of technology, especially e-mail. In reviewing the literature it would appear that most researchers have focused on the potential advantages gained through the use of technology and have ignored potential risks or disadvantages. With the constant pressure to incorporate technology into the lives of individuals and classrooms, the authors hope that this article highlights some of the potential risks of using e-mail and technology and that it spurs empirical investigations of the impact, both positive and negative on individuals. Only through sound empirical investigations can we make accurate conclusions about the impact and usefulness of technology.

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MISMANAGEMENT BY E-MAIL

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In the past, workers have been upset with the abuse of "management by memorandum," a practice in which administrators shotgun employees with mindless drivel or critical edicts that frequently would be served better by personal interaction with relevant individuals or by not being disseminated at all. Next came the fax, little more than an electronically transmitted memo. Today, a modern wonder of technology, the ubiquitous personal computer, linked to a local area network and/or the Internet allows an extension of the drawbacks of management by memo beyond what could have been imagined only a decade ago.

Enter electronic mail or e-mail. E-mail is the practice of sending information from one computer user directly to others, allowing nearly instantaneous transmission of messages, as fast as a person can type, to anyone or any number of people with networked personal computers or mainframe terminals. E-mail may be sent around the globe or to the person in the next office across the hall or at the desk next to the one sending the message.

Empirical evidence of the effects of e-mail are still sparse. Some studies have addressed e-mail as a classroom teaching aid (Allen & Thompson, 1995; Latting, 1994; Rosen & Petty, 1995), while others have explored its use as a research tool (Anderson & Gansneder, 1995; Kittleson, 1995; Mehta & Sivadas, 1995). As is to be expected with such new technology, controlled exploration of the effects of e-mail is in its infancy (Hinds & Kiesler, 1995; Latane & L'Herrou, 1996). Studies of e-mail's influence on management style and employees' attitudes and performance are rare in the professional literature (see Allen, 1995; Markus, 1994; Thach & Woodman, 1994).

However, as the use of e-mail has become common, the popular press has been responsive. For example *Time* magazine documented the explosive growth of e-mail. From 1994 to 1996 the number of e-mail messages sent has swelled from 776 billion to 2.6 trillion, and is expected to top 6.6 trillion by the year 2000 (Gwynne & Dickerson, 1997). These are numbers so huge as to be meaningless to all but federal budget managers. Also, the same article and others (e.g., McNichol, 1997) noted that the effects of the trend to more and more e-mail is far from exclusively positive. A study of Fortune 500 firms (cited in McNichol, 1997) found that 71% of their employees feel overwhelmed by the sheer number of messages they receive every day.

Problems with E-mail Communication

Though e-mail is a genuine boon to some types of communication, especially those at a distance, even on a global scale, it is ripe for abuse. E-mail has been likened to water cooler conversation (Gwynne & Dickerson, 1997) that can be overheard by hundreds or even thousands of people, without the sender knowing howthe message is actually perceived or the reactions it elicits.

An important saving grace of direct, face-to-face communication is that we are forced to speak in an environment that allows, indeed even forces us, to be aware of how our message affects others. Even the telephone provides voice pitch, tone, and volume cues, along with rate of speech to aid understanding. We tend to alter our communication based on many subtle, nonverbal cues we perceive in our listeners. With e-mail, these cues are absent for the sender and the receivers alike. When we are forced to evaluate messages without adequate cues (e.g., e-mail), we tend to do so in a negative fashion (Maslach, 1979; Marshall & Zimbardo, 1979). Such messages readily can foster ill will among those who read them.

For the bottom line, ask most entertainers or teachers whether they prefer to perform before a live audience or a camera and we see immediately why production companies go to great expense to equip studios with warm bodies and teachers prefer to teach real classes. The key is immediate and ongoing feedback, which is lacking with e-mail.

Also, in a society fraught with evidence of increasing personal isolation (e.g., a larger proportion of marriage-aged persons choosing to live alone and doing so longer), the computer makes it easier than ever to avoid personal contact. We find ourselves increasingly sequestered at our desks, behind closed doors or within individual cubicles hunching over the keyboard. This is especially true on the

job, as has been so aptly satirized by Scott Adams of "Dilbert" fame (Adams, 1996). Noting e-mail's major contribution to this bothersome trend, even some computer companies, like multi-billion dollar Computer Associates International (CAI), have banned e-mail at certain times of the day and Charles Wang, CEO of CAI, states that, "It worked wonderfully. People are walking the corridors again talking to other people" (quoted in Gwynne & Dickerson, 1997, p. 88).

Also, record numbers of Americans (at least 35% of adults, according to Hellmich, 1997) are significantly overweight and out of condition (Rather, 1997). Each successive report suggests the problem continues to worsen. The widespread pursuit of passive or sedentary activities play a part in this problem. Untold hours a day staring at a computer screen, only vicariously interacting with the environment and others, cannot help but contribute to the continuation of this unhealthy trend. In discussing health issues, Vice President Al Gore recommended that we get up, physically move around, and spend more time personally interacting with co-workers (Hellmich, 1997).

There are other risks of heavy, uninterrupted computer usage. Increasing awareness of repetitive stress injuries such as carpal tunnel syndrome, including lawsuits directed at computer manufacturers (DEC Pays, 1997), have highlighted possible consequences of over-reliance on computers for simple, routine tasks. Intra-office communication is one activity that might better be accomplished by other means.

E-mail also contributes to what has been labeled "artificial urgency" (Howard, 1997). Since it is possible to send information, requests, and demands instantaneously, there is a tendency to expect results in the same manner, not considering the processes and time that might be required to produce a meaningful reply. As Howard puts it, "I e-mailed you four minutes ago. Where's my response?"

Another problem using e-mail for managerial communication was identified by a recent court ruling. E-mail can violate open meeting laws (Cauchon, 1997). This is an ongoing concern for elected officials at state and local levels who are frequently carefully monitored by concerned citizens and action groups. In fact, Cauchon reported that a Maryland community college returned $25,000 in computer equipment to avoid the possibility of such legal entanglements. The problem seems to appear when *group* e-mail discussions are initiated, appearing to function like a meeting.

Finally, since e-mail can follow us around the globe, including to our homes and elsewhere, we may be on the verge of a dangerous possibility of completely blurring the division between work and other legitimate activities such as leisure, marriage, child rearing, and personal development (Juersivich, 1997; Sloan, 1997). Many workers are familiar with this scenario: "You have a computer at home, don't you? So, let's get you online there, too." This may be followed shortly by, "Be sure to take your laptop or notebook on vacation with you, in case an emergency comes up." And, if we go along with these intrusions into other legitimate life domains, but do not respond quickly enough, we might hear, "Don't you check your e-mail? You need to do so at least every hour." Most of us need timeout-sanctuary from the firm, our position, professional responsibilities, the boss, subordinates, and/or the board. We may ultimately wonder why we should take a vacation at all, if work follows us anywhere and everywhere.

Factors that Encourage Management by E-mail

Given societal and systemic contributors to the trend toward isolation and sedentary pursuits and attendant problems, all of which over reliance on e-mail compliment and enhance, what are some personal and other issues that cause organizational leaders to rely on this impersonal means of communication? The reasons, of course, are as varied as the persons who have become dependent on the addictive e-mail drug. However, we can scratch the surface.

First, because of the lack of personal contact, e-mail allows those with a facility with words, but a paucity of substantive ideas, to hide from immediate interactive processing with others. Problematic or challenging e-mail replies may be deleted without being read and considered, cognitively or emotionally. Hence, management by e-mail is ideal for those who lack viable ideas, support for those ideas, self-confidence, or the conviction of their decisions and actions. All the while, these administrators are busy doing something at their keyboard-laden desks. E-mail is great for those who confuse a flurry of activity with productivity or results.

Also, e-mail allows a relatively safe existence for the person who has been labeled a "virtual manager." This is one who is defined as a "conflict avoiding character... [He or she] hides behind e-mail and uses it as an instrument of aggression, creating not only ill will but vast inefficiencies as well" (Gwymn & Dickerson, 1997, p. 89). E-mail is "perfect for managers who would rather do anything other than walk down the hall" (Gilman, quoted in Gwynne & Dickerson, 1997, p. 89), or we might add, who would rather do anything other than talk with people.

Because edicts and directives can be disseminated as easily as they can be typed or cut-and-pasted from other documents, it is easy via e-mail to bombard employees, often *all employees*, using a single macro-generated key stroke, with a barrage of material. Much of this material may be of questionable use to anyone. Even more, it is especially tedious to wade through, day after day, for those whom the messages are irrelevant. There are accounts of employees getting 200-300 e-mails a day (Gwynne & Dickerson, 1997)!

Further, since messages can nowbe delivered as quickly and haphazardly as they are conceived, at least by a moderately efficient touch typist, the old system of checks and balances, where an angry or aggressive admonition or unfeeling criticism would be allowed to cool because time was required to generate a presentable copy and make the delivery, is now gone. People can lash out as emotions strike them. Often writers only know that they feel better having gotten something off their chests, without a clue as to how those receiving such messages may agonize over them, mulling them over and reading between the lines, all the while ingesting massive quantities of antacids or seeking therapy. Such organizational knee-jerk e-mails may be likened to what can happen in domestic quarrels when a loaded gun is available.

Despite its drawbacks, lightning quick means of information dissemination are godsends for some types of communication. For example, it is great for announcements and interacting with people halfway around the world. It can also be a wonderful way to leave important messages and can even be set up to provide a modicum of security of communication, in some cases. But it is a lame substitute for two-way interactions with persons/employees 10-50 or even a 100 feet apart. We need not only the checks and balances in our interactions that eye-to-eye contact affords, but most of us need the physical activity which accompanies it, along with the serendipitous generation of ideas that occurs with such interactions.

How to Deal with Virtual Managers

As with any problem, human ingenuity provides answers to dealing with the virtual manager, some more proactive than others. In fact, a recent computer magazine outlined some of the more harmful in great detail in an article colorfully entitled, "How to use technology to get ahead, torture your enemies, and destroy the competition... without getting caught" (Jerome & Taylor, 1997). However, we believe there are positive means to thwart the e-mail addict.

Number one is to challenge the e-mail manager with personal replies whenever possible. Sit in the virtual manager's office or waiting room and actually demonstrate how to interact in person. In a pinch, even repeated phone calls can eventually get the message across. Also, do not underestimate the power of direct feedback during one-on-one contacts when they do occur. Let the sender know if either the medium, the message, or both seemed inappropriate. Let the sender know what you understood to have been conveyed from your perspective, and how you felt when you read the e-mail.

For example, "you said in your e-mail that... and when I read it, I felt ..." It can be helpful to have a copy of the actual e-mail in hand. Senders, when confronted with off-the-cuff missives, have been known to admit that they acted inappropriately, or responded out of anger, or the e-mail should not have been directed toward you.

If you decide you must respond to inappropriate e-mails via the keyboard, it may help to do so with a reasoned and logical reply, and get as many others as possible to do the same. Also, it may not hurt to keep copies of all e-mails and your replies, then forward them to the administrator's supervisor, if inappropriate e-mails continue. In some situations, higher level managers are not early adopters of new technologies, hence they may have no idea of howhe equipment they have provided their workers is actually being used.

How to Avoid Becoming a Virtual Manager

"Workers have all this incredible communications technology at their disposal, but often what people really want is two minutes face-to-face with a boss or co-worker" (Darrah, cited in McNichol, 1997, p.6). Believe it, remember it, and DO it! Think before pushing the send button. Would you want to receive the message being sent? Also, do not send copies to everyone you know or everyone in the work setting. Who has a genuine need to know? For whom is the message irrelevant or worse? Just as one can make an all inclusive list of e-mail addresses attached to a "hot-key," so can one create more specific listings, directories that might represent more appropriate groupings of receivers of some messages, but not others. Finally, consider shutting down the e-mail system at regularly scheduled intervals. Otherwise dealing with e-mail might not just interfere with work, it may actually become the work (McNichol, 1997).

Conclusion

We have mentioned e-mail addiction in passing in this paper. However, it has been found that people can become addicted to e-mail (Juersivich, 1997) in much the same manner they can become addicted to virtually anything else, from gambling and video games, to running, eating, smoking, drinking, or sex. At that point we are no longer just "wired" into the computer network, but are "chained" to it. As one self-proclaimed e-mail addict put it, "To me the ultimate tool would be to have an e-mail terminal implanted in my head" (Juersivich, 1997, p. 9D). In reply, we say to such managers and workers alike, get a life! Talk with people and enjoy the personal interactions, as you nurture yourselves and your relationships. You will probably find you are also helping your job evaluations and your careers.

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Interaction Management Strategies on IRC and Virtual Chat Rooms

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Internet Relay Chat (IRC) is an electronic medium that combines orthographic form with real time, synchronous transmission in an unregulated global multi-user environment. The orthographic letters mediate the interaction in that users can only access the IRC session through reading and writing. They have no access to any visual representations at all. The 3-D virtual chat environment is available to computer users for interaction. In addition to all the characteristics thaCIR has, the 3-D virtual environment supports users with three-dimensional graphics that represent an individual through the use of an avatar in a virtual environment.

The 3-D virtual chat room can be considered a community of practice. A community of practice is defined by Eckert and McConnell-Ginet (1992) as "an aggregate of people who come together around mutual engagement in an endeavor. Ways of doing things, ways of talking, beliefs, values, power relations-in short, practices-emerge in the course of this mutual endeavor" (p. 464).

It was initially believed that the discourse in the chat room would be linear, and therefore, easy to analyze. However, after collecting the data, the very complex nature of the discourse pushed this assumption to another important realization. Instead of focusing on the non-linear conversation (which is the type of discourses in the chat rooms) from a linear (real-life, face-to-face [FTF] conversation) point of view, the scope of the investigation was changed in order to explore the nature of discourse in 3-D virtual chat room where the visual images accompany the conversation. This is in contrast to IRC discourse, which does not allow users to benefit from visual images.

Thus, the research questions for this study were:

1. What is the nature of the context of discourse in a 3-D virtual chat room?
2. Is the 3-D virtual chat room different from text-only (non-virtual) chat room interaction in regard to invitations of speech acts?

Literature Review

The social interactions have been studied for over 25 years in order to find the patterns, routines, and the convention-based behavior in interpersonal interactions. Discourse analysis on real life, face-to-face interaction has been used to define the nature of interaction in terms of regulation (Burgoon, Buller, & Woodall, 1995; Cohen, 1996), and management (Rintel & Pittam, 1997). However, the developments in computer technology have introduced another aspect of interaction that takes place in a computer-mediated environment: computer-mediated communication.

The studies about computer-mediated communication (CMC) date back about 15 years. Early studies of CMC asserted that text-only CMC systems filtered out most social-contextualization cues and therefore greatly limited the interaction management possible for this type of social and interpersonal communication (e.g., Kiesler, Seigel, & Mcguire, 1984). However, in the early nineties, several research studies criticized this view for not considering the possibility of interaction adaptation that is claimed to occur in time by the users (Reid, 1993, cited in Rintel & Pittam, 1997). Recent research has also investigated the possible effects of interaction management strategies used in an interactive CMC medium (Rintel & Pittam, 1997).

The studies about the challenge of producing more contextually appropriate speech refocus attention on an important aspect of language use: speech acts. In terms of this study, a speech act is defined as a functional unit in communication. According to Austin's theory of speech acts (Austin, 1962), the functional units have three kinds of meaning: locutionary or propositional, illocutionary, and perlocutionary meaning. A more detailed summary of Austin's theory of speech acts, including a brief historical overview, appears in Cohen (1996, Ch.12).

The locutionary meaning is the literal meaning of the utterance or written text itself. These statements refer to what can be called objective reality on to the explanations or the declaration of the obvious situation. For example, if one person tells you that "I like dancing," the locutionary meaning would concern one of his/her favorite hobbies or activities.

The second kind of meaning is illocutionary, which implies the social function of the utterance or written text. In this case, you not only share that information, but also infer something from the statement within its own social context. The illocutionary meaning from the previous example, for instance, would be that he/she wants to go somewhere and dance.

The perlocutionary meaning is the reaction to the received stimulus in a given context. Thus, if the utterance leads to an action of taking the person to a place to dance, then the perlocutionary force of the utterance would be greater than if the request is ignored.

In real life conversational interactions, such speech acts function as determinant factors in sustaining interpersonal relationships. Invitation is one of the speech acts that initiate such an interpersonal relationship. Based on the functions of speech acts, the performance of an invitation sets up a sequentially possible next act as either acceptance or a rejection. Many researchers conducted studies to determine the patterns and the norms of real-life interpersonal communication as far as invitations are concerned (Wolfson, D'Amico-Reisner, & Huber, 1983). The patterns and the norms in non-face-to-face environments are yet to be investigated.

Rintel and Pittam (1997) investigated the interactions that develop interpersonal relationships within a socio-emotional context and the strategies employed by the users throughout the interaction process. In their study, the writers compared the CMC interactions that occurred in IRC with real-life, face-to-face communication interactions during the opening and closing phases. They concluded that interaction management in IRC was similar to that in casual group FTF interactions in terms of the general functions of the strategies used, but that the content, structure, and ordering of the strategies are considered to be subject to adaptation.

Rintel and Pittam (1997) also proposed a framework for interaction management on IRC based on their research findings. These proposals will be quoted from their research:

Stage 1: Server announces presence of newly joined user to all channel participants

Stage 2: Exchange of exploratory/initiatory linguistic tokens- repeat as necessary:

a. "blind," traditional mass greeting token to all users or
b. traditional token to individual users (followed by other phatic communication or the use of another strategy) or
c. statements or questions (interaction may follow with or
d. without overt phatic tokens)

Stage 3: Textualized exchange of conventional nonverbal contact gestures of greeting (as appropriate to relationship)- may not occur.

Stage 4: Transition signals for moving to the medial phase (pp. 527-528).

Although there is research showing the framework of IRC interaction management strategies and the comparison between real life FTF interaction and CMC, there is no research investigating the nature of the context of discourse in a 3-D virtual chat room and how 3-D virtual chat differs from text-only IRC chat. In this research, the focus is on opening sequences and on invitations as being particularly important to the establishment and maintenance of interaction, and therefore the interaction management. This research examines the extent to which these are similar to, or different from, IRC interactions, and proposes an explanatory framework for this type (3-D virtual chat) of interaction management.

Methodology

The data were collected at a virtual chat room called Active Worlds which is a 3-D virtual chat room that enables users to interact via, typed messages while representing them with 3-D avatars. The interaction between participants was initiated and maintained through typing similar to IRC chat, but participants could see each other via their avatars on the screen as they typed during the interaction; moreover, their typed speech appeared above the head of their avatars.

There are two ways to participate in conversations in Active Worlds; either as a "tourist," or as a "citizen" (the terms used by the channel owners referring to members and non-members respectively). The "citizen" participants also see themselves as being "a community" in their homepage. As a community, they communicate and interact with each other based on a series of practices in an endeavor. In the course of this "mutual endeavor," they establish their "ways of doing things, ways of talking, beliefs, values, and power relations."

The data collected for this study consisted of five 50-minute logs (written discourse) that occurred at the Gate, which is the entrance to the 3-D virtual chat room. This place was selected because it is a location where everyone has to stop before entering a chat session. The Gate functions as a social gathering room where people initiate conversation, meet each other, and invite each other to other places within Active Worlds. This function of the Gate was the ideal location to look at this community of practice. Yet, there were some disadvantages, too. Since all users stop at the Gate, there was no stability with the users. At any time, a new person could join the conversation. Second, people were free to choose a nickname for themselves and could change their nicknames at any time. Thus, it was impossible to provide any personal information about the participants such as, how many people were in the study, how old they were, their gender, etc.

In the Active Worlds, programmers post statistical information about the daily use of the resource. For the previous three weeks, the peak times for the Gate were reported by the program developers to be weekends,

between 12:00 to 2:30 p.m. Therefore, it was decided to collect the data on three consecutive weekends between 1:00 to 1:50 p.m., to ensure a relatively large amount of observable interaction.

As a qualitative form of analysis was being undertaken, the transcripts were read several times independently, and the context of opening phases and invitations were examined for all interactions that took place. Content analysis was employed to code interactions during opening phases and invitations.

The primary set was to explore and compare the data and with the IRC interaction findings of Rintel and Pittam (1997). The aim, therefore, was not to make generalizations about interactions on virtual chat rooms but to show a range of possibilities that illustrate how text-only (IRC) and text-visual (virtual) rooms present similarities and differences shaping the norms and the patterns of the social interaction. Examples are presented here from the captured screens to illustrate the points being made with no spelling or grammar corrections, and are provided with line numbers as they appeared, along with the discourse and the log numbers. The nicknames were also changed to pseudo-names to ensure anonymity of the participants.

Findings: Similarities and Differences

The interaction management strategies found in the data have been categorized under a single general heading: opening phase and invitation. These phases will be discussed in terms of their similarities and differences to IRC; and, the functions they appear to serve will be discussed in terms of two subheadings*interpersonal goals*, how people introduce each other to draw attention; and, *level of experience and acquaintance* how experience plays a role in interactive communication.

Opening Phase and Invitations

Interpersonal Goals. Rintel and Pittam (1997) reported that in order to help create a good initial impression for the desired respondent, the choice of the nickname is crucial in a CMC environment. The choice of a nickname can refer to personal unity; moreover, it may make the other participant speculate about the user's identity. Such implications of nickname choice can be seen in the example below:

(Log 6)
85 "Ana": Is there anybody out there?
86 "spain": Hi all
87 "Ana": You must be from Spain

Rintel and Pittam (1997) also report that some users hide all personal information, especially to present selectively gender-switched or even multiple identities. In this research data, however, no cue is reported to show the relationship between nickname choice and gender. Yet, it is northworthy that CMC is an environment where virtual gender-swapping is particularly significant (Turkle, 1995). Although it is impossible to find out whether the person in the chat room is gender-swapping, it is sometimes possible when users themselves choose to reveal this information, as shown below:

(Log 4)
138 Kataline: How come no one is talking today
140 Suyev: Kataline Ill talk with you
163 Kataline: are you male or female
166 Suyev: male today
171 Kataline: Just today?
172 Suyev: Well I'm preety sure all of the time

Since it is not possible to find out which of the statements is fictitious, it can only be speculated that gender seems to be a conscious personal choice to initiate conversation. Elsewhere, gender is pointed out to be a primary concern in initiating the conversation.

(Log 3)
5 child: Cat, I'm female
8 Cat: Angel would you like to talk in metropolis
15 child: Are there any guys in here who want to chat with a 13 y/o f?

In this conversation, 'child' is trying to draw Cat's attention to initiate conversation by imposing her gender first. Cat seems to be obvious of the illocutionary force (meaning) of this statement. Yet, s/he begins by including her age. She receives no response to chat from Cat. This may be due to the fact that she did not start with appropriate opening linguistic tokens.

(Log 6)
27 Roze: hiya
28 Cindy: where r u from
30 Roze: is from NH, USA
31 Cindy: me too
33 Cindy: r u a boy or a girl
34 Roze: is 17-year-old single male
36 Cindy: u r to young for me, I am 24
37 Cindy: I am a single girl who is 24 I live in Atlanta

Although the discourse, here, seems to be contextually appropriate, the desired result was not achieved possibly due to the fact that age seems to be more important in order to continue the discourse. In initiating the conversation, Rintel and Pittam (1997) report that repetition is a necessary part of conversation. They also suggest that the use of capital letters are important aspects of the discourse. In this data, the same strategy is found to be applied by the participants. Capital letters were used to either draw attention or to emphasize a point. Several repetitions also are aimed at drawing attention and initiating conversation.

(Log 6)
70 Jey: HELLO EVERYONE
72 Saturn: WHAT DID YOU ASK?

(Log 4)
38 Silver: ANGEL ???
39 Silver: ANGEL?!?!?!?
40 Silver: ANGEL ???
43 Silver: ANGEL?!?!?!?
45 Silver: DO you want to go somewhere with me Angel?

On IRC, the perception and reflection of feelings are reported to be highlighted by the use of textual symbols such as exclamation marks, possibly used with greetings. In a 3-D virtual chat environment, typing is a mode of communication that is applied by the interactive users. In addition to this, the software enables the users to reflect their feelings of "anger," "happiness," "sadness," and physical response for appreciation through avatars. The following example shows the similarity between two chat environments.

(Log 3)
162 Angel: booooorrrriiinnnnnngggg...
160 Angel: hmmmmmm.....<yawn>
35 Sun: ^__^

(Log 6)
66 Saturn: AAAAAAAGGGHHHH

Similar to IRC, 3-D virtual chat rooms are missing all physical and social contextualization cues regarding status differentials unless the participants explicitly verbalize it. Rintel and Pittam (1997) argue that "by the time enough social status information is known to make status judgments, the interpersonal relationship will have formed in an environment conducive to equality" (p. 517). In 3-D, the establishment of social status is recognized as equal to develop interpersonal relationships and invitations.

(Log 2)
150 Lady: where do you go here duke?
157 Lady: would you like to see my duke?
158 Duke: ya my house but I hardly have the time to work on
182 Lady: iam going ther to built now

In this conversation, it is clearly seen that Lady is trying to establish a social context to initiate a conversation with Duke. For the two, having a house in the 3-D environment is a commonality which is expected to have them interact. In addition to this, there is an implicit invitation coming from Lady. Yet, it is hard to declare explicitly that their social solidarity (having a house) is the reason to participate in an interpersonal conversation.

Level of Experience and Acquaintance. Actually, IRC and 3-D virtual chat rooms are two different kinds of software in terms of their technical capabilities. On IRC, a person's nickname is presented to others on the screen by the server involuntarily. However, in Active Worlds, avatars descend from the top onto the stage when participants enter and dissolve from the screen when they quit.

Rintel and Pittam (1997) point out that depending on the number of people on the channel, newly joined users were introduced to others in the channel. Yet, due to the lack of visual cues and geographic separation of participants, they claim that there was a scope for conflict between the initially and propitiatory functions of "phatic" communication. In the 3-D virtual chat environment, however, the participants are virtually able to see each other on the screen via their avatars.

(Log 3)
243 Chantal: You will see people and you will be able to talk
246 Chantal: its more graphic and you have a body...

Body movement seemed to be an important aspect of interpersonal communication in 3-D virtual chat. Participants tend to complement their orthographic scripts with virtual appearance. Thus, visual appearance seems to function to overcome the separation of participants.

(Log 2)
15 Jean: I'm going sky diving next weekend :p
16 boabum: I am right in front of you
17 Jean: Wish me luck.
18 Angel: good luck
25 Jean: Can ya see me? :)
33 Jean : Move toward me.. You are in a pile of p(*people)*
[italics are added]

In this conversation, Jean thinks that seeing a person visually is an important aspect of keeping the conversation going. Apparently, in order to sustain the interpersonal relationship, Jean wants his/her partner to see him/her as well. Different from text-only environments, the interaction is initiated and maintained around the notion of having a body.

A Proposed Framework For Interaction Management On 3-D Chat Room

Based on the data collected for this study, it is observed that there are some similarities between IRC and 3-D chat rooms. However, in some ways, 3-D virtual environments differ from IRC. The framework developed by Pintel and Pittam (1997) for IRC interactions do not exactly reflect the findings for a 3-D environment. Nevertheless, the functions that the behaviors serve are analogous in the two media. Although the opening phase and initiative speech acts were found to be similar in both chat rooms, in the 3-D chat room, the visual representations of the participants, avatars, are found to be important for the establishment and maintenance of interpersonal relationships. The examples illustrated under the categories of interpersonal goals and levels of acquaintance illustrate this point.

Referring to the framework explicitly proposed by Rintel and Pittam (1997), some changes were made to propose a framework for the sequence of interaction on 3-D virtual environment.

Stage 1: Server drops you off at the Gate

Stage 2: Exchange of exploratory/initiatory linguistic tokens - repetition is necessary.

a. Greetings (personal information in relation to gender, age, and location)
b. Statements/questions (locutionary and illocutionary statements are explicitly used, whereas perlocutionary forces were hardly identified)

Stage 3: Textualized exchange of conventional nonverbal contact gestures of greeting as well as visualized exchange of nonverbal contact of gestures.

Stage 4: Transitional strategies for moving to the appropriate speech act based on the appropriate context.

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BRINGING INTERACTIVITY TO THE WEB: THE JAVA SOLUTION

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Java is the object-oriented programming language that has taken the Internet by storm. Java's popularity lies in its ability to create interactive Web sites across platforms. Because of Java, the Internet no longer need remain a static vehicle. It becomes a truly interactive tool for the user.

The most common Java programs are applications and applets. Applications are stand-alone programs, such as the HotJava browser. Applets are similar to applications, but they do not run stand-alone. Instead, applets adhere to a set of conventions that lets them run within a Java-compatible browser. Applets are essentially embedded in HTML pages for Web viewing (Musciano & Kennedy, 1997).

Java was first "brewed" in 1990 when a handful of developers at Sun Microsystems set out to build a device that could control everyday consumer appliances ranging from coffeepots to VCRs. Soon the vision expanded to include a device that could potentially serve as an interface to the Internet. Late in 1991, an object-oriented programming language called Oak was developed (Scott, 1997).

Sun wanted to build a system that could be programmed easily without a lot of esoteric training. While the developers found the existing programming language, C++ to be unsuitable for their needs, they designed Java as closely to C++ as possible in order to make the system easier to understand. In January 1995, just as it began to attract serious attention from the greater Internet community, the Oak programming language was renamed Java.

Java is fast becoming an essential subject matter and teaching tool within corporate and academic settings. Corporations are sponsoring Java classes for their diverse employee pools. Universities are integrating Java into curriculums as a result of the increasing demand for Java developers. Primary and secondary schools are using Java technology to teach students everything from physics equations to biological processes. Java could very well become one of the foundational tools for the classroom of the future, one that allows for a rich, interactive education. Integrating the Web into the curriculum is greatly enhanced when the interface to the Internet is interactive. Java is making that a reality. In this paper, we will explore the growth of the Java language as a tool for use in teacher education as well as the K-12 classroom.

Bowen (1996) states that "The Java programming language is gaining popularity in university and community college curriculums-as a first programming language, as a general programming language better suited to conveying advanced concepts such as concurrency and distributed objects, and as an Internet-related toolset important in continuing-education programs."

The term "object-oriented" is generally used to describe a system that deals primarily with different types of objects. The actions you can take depend on what type of object you are manipulating. For example, an object-oriented draw program might enable you to draw many types of objects, such as circles, rectangles, triangles, etc. Applying the same action to each of these objects, however, would produce different results. If the action were Make 3D, for instance, the result would be a sphere, box, and pyramid, respectively (Musciano & Kennedy, 1997).

Java and JavaScript

Up to now we have looked at Java applets, which are small programs that are separate from the browser and the HTML document. Java applets run in their own space via a separate execution engine. JavaScript is different! JavaScript is a scripting language that taps the native functionality of the browser. You can sprinkle JavaScript statements throughout an HTML document and Java Script-enabled browsers interpret and act upon the JavaScript statements (Musciano & Kennedy, 1997).

JavaScript was developed to fill the considerable gaps in functionality between HTML, CGI and Java. JavaScript is well suited to enabling users to interact with HTML pages. JavaScript code can respond directly to user interaction with <FORM> elements like text boxes, buttons, check boxes, drop-down selections lists and more. It is excellent for client-side image maps and hypertext links. It can also be used to "spice up" Web pages with the date, time, status bar messages and scrolling banners

What about ActiveX?

One of Java's great advantages is its inherent security. Because it was created to run applications over the Internet, its designers were very concerned about security. They had to be careful to make it impossible for malicious programmers to build Java applets that could reach over the Internet

into users' machines to steal passwords, shut down systems, or perform other unfortunate hacks.

To guard against this, Sun developed the "Java sandbox," (referred to as a virtual machine) inside which Java applets are forced to run. This virtual machine blocks all access to potential danger zones on your computer, such as the hard disk and serial ports. While the sandbox makes Java very safe, it also makes Java work slower and somewhat less efficiently than native applications that run directly on your machine without any intermediary processing (Rowley, 1995).

The sandbox security model is one of the most important political differences between Java and its nearest competitor, Microsoft's ActiveX. ActiveX allows access to these "danger zones" and relies on a model of trust, simply telling users that a given Web site wants to run an ActiveX control and asking if this is okay. Simply asking for your permission to introduce foreign, potentially malignant files is viewed by some people as inadequate security protection. As of this writing, Java applets are installed on approximately 1,000 times more Web sites than ActiveX (Scott, 1997). Security assurances are one big reason why.

Java in Education

There is a challenge involved in integrating Java into traditional education programs: Java is not a static technology—yet. It is not "written in stone" the way Pascal and C++ are. Instructors and students must be prepared for changes both in the technology and in the way that it is taught. In his Java Report article *Using Next Generation Technology for Java Education* Holger Opderbeck, CEO of MindQ Publishing, puts it best: "It's about time we started using the power of modern computing to more effectively teach the complexities of modern computing" (Opderbeck, 1997).

Java is an exciting, dynamic technology that is challenging to teach. With new specifications, new classes, and general updates, one must accept the fact, when teaching Java, that the course will never be the same because the subject matter is in a never-ending state of change. In the past, programming classes were created using the model of "develop the course and then teach." The teaching cycle was typically much longer than the course development cycle. In today's technological environment, curriculum development must be iterative; in other words, it is an ongoing repetitive process that is required due to the constant change of the subject matter and the technology. In order to be Java-compliant, we must follow Sun specifications, which are continually changing. Today, new releases of host-based products are issued every few months, so class material will probably need to be updated on a regular basis.

At Florida Atlantic University, we decided that graduates of the Educational Technology program should have nine graduate hours of programming exposure and its application for education. There are a significant number of institutions of higher education that have made the Java language a core course required prior to C or C+. (McCauley & Manaris report as cited in Culwin, 1997.) Our second course is centered on Java. The purpose of our course was to provide educators with the Java skills to meet their instructional objectives. It takes a lot of planning to put together a course of this nature. We suggest the following outline:

1. Draw up a detailed outline for the class
2. Create a template for content, demonstrations and projects
3. Research content for topics that apply to education – note change
4. Configure technological environment – know your lab and its limitations
5. Design technology demos – use of student work from previous courses
6. Develop the lecture content
7. Develop a resource list of tools, Web sites and projects
8. Develop student and instructor notes via presentation tools
9. Create a plan for updating course materials
10. Develop a list of student objectives or outcomes

We adopted the concepts of object-oriented programming in our course design. Demos are used because a single demo can replace many screen captures. Each new demo file corresponds to a new chapter or topic, and dependencies between chapters and between labs are kept to a minimum. Creating self-contained modules (just like creating objects or reusable components in programming) means that topics can be written independently and rearranged or altered with minimal impact to the other sections of the course.

An FTP site was created for the course so that material can be shared and updated by the students. Student work can be put on the server for all to explore as the course develops. Java students also developed a Web site as a project, an exciting way of using the medium to teach the medium.

Apple's EOE -Educational Object Economy Web site (Apple Computer, 1997) is a community of educators, learners, developers, and businesses, focused on the creation and collaboration of educational activities which include pieces of Java software in them. The EOE is also intended to help educators and learners access this material and the creators of the applets. The EOE has a library of over 1000 pointers to Java applets, over 25% of which make source code available. Working together, the educators, learners, and developers can collaborate to enhance existing material and produce new innovations. Educators with little or no programming background have access to an ever growing library of interactive applets to

use as stand alone teaching tools or as enrichments to Web-based instruction.

The EOE has an exciting future for the educator. Educators are providing information about their favorite applets that they use in their classrooms, what applets work best with the textbooks they are using, hints about lesson plans and materials used to effectively use the Java applets to achieve learning objectives. Teachers also make suggestions for what applets they would really like to see created (teacher's wish lists). The EOE also encourages partnerships between teachers and university Java programming classes, so that teachers have access to programmers and developers who are creating the kinds of learning material the teachers need.

EOE provides an excellent scenario of a fifth grade teacher who finds an applet to teach her class a botany lesson. By working with the Java programmers on the listserv she is also able to have the program modified to fit her specific needs within four days. Java is making the Web an interactive pedagogical tool within the reach of all educators' especially those with no programming experience (Bastiaan, 1997).

Who is building Web sites today? Entrepreneurs, writers, hobbyists, educators and students from the elementary grades and up are building them, not Java programmers. In fact, very few Web sites are actually built by professional programmers. That is why programs like Lotus BeanMachine are important: It brings the power of Java to non-programming Web-builders like teachers and their students.

There are three groups of parts that come with BeanMachine. There are Multimedia parts, such as Animation, Audio, Ticker Tape, and Text. There are Networking parts, such as a Database component, a URL Link for linking to other Web pages, and an e-mail part. The third category of parts is called Controls, which includes all the basic things you need to build data entry forms such as buttons and text fields. Anyone that has experienced a modest amount of Visual Basic will find himself or herself at home with this software but we stress once again, no programming knowledge is required.

Every JavaBean has a certain set of properties, methods, and events. Properties describe the part, its speed, its width and height, etc. Every bean has a different list of properties that makes it unique. Beans are active objects, as they know how to do things. Animations can play and stop. Buttons can show and hide themselves. Again, every kind of bean has a different set of actions it knows how to perform; these actions are referred to as methods. Events help a bean interact with other beans. An event is a signal that something important has happened: a button was clicked, a transition has finished, or a ticker tape was refreshed. In BeanMachine, every part on the palette is a JavaBean, so it has properties, methods (which BeanMachine calls actions), and events (Lotus, 1997). The BeanMachine is just one example of software that will allow you to "brew a perfect cup of Java" for your next Web page without really learning how to program in Java.

Conclusion

Java is becoming a basic skill for a wide range of students and teachers, not only for programmers. Educators are beginning to recognize that today's students need to learn logic, or "higher order process skills," at an early age. Java helps students develop their logical or "object oriented cognitive skills," an understanding of how, for example, the "objects" of car, truck, and sports car relate to each other. This notion of objects and their relationships, of classification and sub-classification, is important in disciplines ranging from art to chemistry, and it is fundamental to the Java environment. The skills it teaches are crucial, for logic is the essence of cognition, and language is its tool (Spohrer & Wolpert, 1997).

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Additional Resources

- Doug Lea's Q&A on using Java at SUNY-Oswego
  http://g.oswego.edu/dl/html/javaInCS.html
- Sun Microsystems resources on Java in Education
  http://www.sun.com/edu/java
- Selected Java newsgroups
  comp.lang.java.programmer — Java language discussion
  comp.lang.java.misc — IDEs, books, etc.
- Java FAQ - includes selected Books and language information
  http://sunsite.unc.edu/javafaq/javafaq.html
- Java Booklist
  http://lightyear.ncsa.uiuc.edu/~srp/java/javabooks.html

- Web technologies, including Java, in teaching
  http://www.npac.syr.edu/users/gcf/webwisdomapr96/
- Sun Microsystems Java CourseWare Page
  http://www.sun.com/edu/java
- Sun Microsystems resources on Java in Education
  http://www.sun.com/edu/hot/java/index.html
- Footprint Software
  http://www.footprint.com

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FCC's E-Rate Discount Program - What is it all About?

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In an era of increasing international economic competition, the quality of America's elementary and secondary schools could determine whether our children hold highly compensated, high-skill jobs that add significant value within the integrated global economy of the 21 century or compete with workers in developing countries (Shaw, 1997).

On June 29, 1956, President Eisenhower signed the Federal-Aid Highway Act of 1956 into law. President Eisenhower had tried for a number of years to get an Interstate Highway bill through Congress. Senator Albert Gore, Sr. of Tennessee, who was chairman of the Senate Subcommittee on Roads, had also worked diligently for a federal Interstate System and was instrumental in getting the Federal-Aid Highway Act of 1956 approved by the United States Senate. This one act continues to have immeasurable impact on the economy of the United States and was considered one of President Eisenhower's favorite domestic program. Eisenhower's 1963 memoir, Mandate for Change 1953-1956 (Weingroff, 1996), explained why:

> More than any single action by the government since the end of the war, this one would change the face of America. ... Its impact on the American economy - the jobs it would produce in manufacturing and construction, the rural areas it would open up - was beyond calculation.

Exactly 40 years later Congress approved another historic highway act. This time the visionary champion was Vice President Gore, son of Senator Albert Gore, Sr. History may document that the new global highway system, the Information Super Highway, will have a greater impact on the economy of the Unites States than the concrete and steel national Interstate Highway System that was started in 1956. In February of 1996, President Clinton signed the Telecommunications Act of 1996 into law. This new Telecommunications Act contains many components that will allow the Information Super Highway to flourish. An important universal service amendment of the Telecommunications Act of 1996 was the Snowe-Kerrey-Rockefeller-Exon Universal Access Amendment to the Telecommunications Act of 1996, which required that elementary and secondary schools and public libraries be provided affordable telecommunication services.

On May 7,1997, the Federal Communications Commission (FCC) issued a ruling on Universal Service that would provide $2.25 billion a year in telecommunication discounts to K-12 schools and public libraries. This historic FCC ruling has the potential to make a significant impact on the quality of graduating high school students. Due to the expanding global economy of the Unites States, graduating students must possess the skills needed for the United States to continue to be competitive. The FCC's ruling approved the Education Rate Discount Program or E-Rate that will significantly discount the cost of providing Internet connections to over two million classrooms in approximately 106,000 schools in the United States and thousands of public libraries.

Chairman Hundt of the FCC described the E-Rate discount program as: "the biggest single national effort to change education in K-12 classrooms in the history of our country" (Hundt, 1997). Vice President Gore stated that the FCC decision was historic and America "...has taken a great step forward in closing the gap between the information haves and the information haye-nots" (Gore, 1997).

In addition, Chairman Hundt stated that many years ago the seeds for Universal Service were planted during a conversation with then Senator Al Gore. Former Senator Gore stated that he wished that all students could be provided the opportunity to learn from the limitless resources of the Library of Congress without being barred by time, distance, or money (Hundt, 1997). As a result of this initial and informal conversation between then Senator Gore and Chairman Hundt, a national vision of connecting all American classrooms to the Internet developed. Chairman Hundt also stated that Vice President Gore actually coined the phrase, Information Highway (Hundt, 1997).

Thanks to the efforts of thousands of dedicated professionals, the national vision of connecting every classroom in America to the Global Information Highway is going to become reality. Additionally, because of the FCC's E-Rate discount program, many of America's classrooms will be

connected to the Internet by the end of this century. Credit for the E-Rate initiative not only goes to Vice President Gore and Chairman Hundt, but also to President Clinton, other dedicated officials of the FCC, the U.S. Department of Education, Senator Snowe of Maine, Senator Rockefeller of West Virginia, Congressman Markey of Massachusetts, the National Education Association, the National School Boards Association, and to 30 national education and library organizations in the Education and Libraries Networks Coalition.

Major Components of E-Rate

The FCC Education Rate discount program was implemented on January 1, 1998 and is projected to continue to discount telecommunication services for K-12 schools and public libraries indefinitely. The FCC is scheduled to complete an in-depth review of the E-Rate program five years after implementation. The following is a summary of the major components of the E-Rate discount program as described in the FCC's Report and Order that governs the E-Rate program (FCC 97-157, 1997).

Eligibility Criteria

All state and federally funded elementary and secondary schools and public libraries in the United States are eligible to receive E-Rate discounts. In addition, many private elementary and secondary schools may also qualify for discounts. Private schools must be non-profit and can not have endowments in excess of $50 million. However, Institutions of Higher Education are not eligible for E-Rate discounts.

How E-rate Works

The E-rate program is not a federal grant program. Also, the E-Rate discount program does not require matching funds. Instead, eligible elementary and secondary schools and public libraries will receive telecommunications services at significantly reduced rates. Formal applications and other certification requirements must be completed by all schools and libraries requesting telecommunication discounts under the E-Rate discount program. Schools or a consortium of individual schools must also annually submit their requests for eligible services for competitive bidding at the national level.

The funding period will be each calendar year and schools and libraries will only be required to pay their portion of bills for telecommunication services after the discount has been applied. For example, a school that is eligible to receive a 70% discount will only be required to pay 30% of the bill. Each service provider or contractor will submit invoices directly to the Administrator of Universal Service for reimbursement of the remaining 70%. The FCC has designated the National Carriers Exchange Association to manage the E-Rate program.

Table 1.
E-RateDiscountMatrix

% of Schools and Libraries Eligible for National School Lunch Program	Urban Discount (%)	Rural Discount (%)
<1	20	25
1-19	40	50
20-34	50	60
35-49	60	70
50-74	80	80
75-100	90	90

(FCC 97-157)

E-Rate Program Discount Rates and E-Rate Funding

The discount percentage level may be figured by individual schools or by school districts. Eligible libraries receive the same percentage as the school district in which they are located. The discount percentages will very from a low of 20% to a high of 90% and are based upon two factors, the percentage of students eligible for free or reduced price lunches under the National School Lunch Program and a pre-determined rural or urban status of schools or school districts (see Table 1). The FCC projects that many schools will be eligible for 70% or 80% discounts.

Funding for the E-Rate program will be collected from all telecommunications carriers that provide interstate telecommunications services in the United States. A total of one billion dollars will be available in 1998 and $2.25 billion will be available annually starting in 1999.

Eligible Telecommunication Services

The FCC wanted to assure that schools and libraries have maximum flexibility to design and purchase the telecommunication services that best meets their needs. As a result, all costs associated with providing telecommunication services to schools and individual classrooms are eligible for E-Rate discounts. Included are costs associated with rental of digital Internet access lines, Internet access charges, regular phone line charges, file servers, routers, terminal servers, wiring, wiring connections, wireless connections and associated equipment, networking software, and all maintenance associated with maintaining computer networks.

Telecommunication Services Not Eligible for E-Rate Discounts

Teacher training, computers (unless used as file servers), content related software, fax machines, electrical system upgrades, remodeling of buildings to accommodate newly acquired technologies, and asbestos removal are not covered under the FCC's E-Rate discount program.

Application and Certification Requirements

Individual schools or consortiums of schools and libraries are required to submit an application, a completed technology plan, and other certification requirements. More information, applications, certification requirements, and instructions are available from the FCC.

Two Major Challenges of E-Rate

The E-Rate program is by no means guaranteed to become a national success story in the majority of K-12 schools in America. The very nature of E-Rate requires a great deal of effort by all educators, both from K-12 schools and from Institutions of Higher Education to impact the quality of graduating students. All administrators must realize that important challenges are packaged with the E-Rate program. The administrator's role in changing the school to a more technological based learning environment that provides connectivity to all students is critical for E-Rate to become a success story.

The Major Challenge for K-12 Educators

Administrators of all K-12 schools must assure that their priorities in networking classrooms and schools to the information highway are carefully analyzed. The most important variable for successful integration of Internet and other technologies into classroom curriculums is teacher training. The E-Rate program will save schools significant funds that would otherwise have had to be spent on networking and other Internet related costs. School administrators need to assure that some of these savings will be redirected into formal teacher training programs. All teachers not only need to be taught how to use Internet and other computer technologies, but they must be taught how to use technology as a transparent tool to facilitate learning of the required basic skills and other core subjects.

The Major Challenge for Colleges and Schools of Education

The following quote is from the 1997 Report to the President on the Use of Technology to Strengthen K-12 Education in the United States (Shaw, 1997),

> ...even in states with a technology-related certification requirement, new teachers typically graduate with no experience in using computers to teach, and little knowledge of available software and content. The Office of Technology Assessment summarized the current situation concisely: Overall, teacher education programs in the United States do not prepare graduates to use technology as a teaching tool.

The President of the National Council for Accreditation of Teacher Education (NCATE) has stated that, "...most schools of education have not yet fully integrated technology into their programs for preparing teachers. There is a long road ahead" (Wise, 1997). The time is now! Schools and Colleges of Education must start properly preparing pre-service teachers to use Internet and other technologies in their future classrooms.

Conclusion

The Federal-Aid Highway Act of 1956 dramatically impacted the economy of the United States by putting rural areas on the map and connecting cities and people. The E-Rate program was created from the Telecommunications Act of 1996 and has the potential to have an even larger impact on the United States because for the first time, students from all over America will have instant access to global sources of information. However, unless the two challenges described above and other educational challenges are not met head on and conquered, the potential impact of the E-Rate program will be disappointing to say the least.

No longer can we prepare students without classroom connectivity to the multitude of informational resources of the world. The World Wide Web will be the tool of students and adult learners of the 21st Century as the printing press was used as a tool by previous generations. The E-Rate Discount Program makes it possible for all schools to make the connection between new teaching techniques, great resources, and innovative learning environments.

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Administrative Concepts for the Secure Use of the Internet at Schools

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A growing number of schools in Germany are being connected to the Internet. This goes along with an increasing use of the World Wide Web (WWW) in schools. The Internet is mostly used as a means for searching the WWW or for getting into contact with pupils from other schools by e-mail or other communication facilities, such as bulletin-boards or discussion forums. Furthermore, Internet-based learning environments that provide tutorial components as well as communication features are made use of (Cremers, Lüssem, & Sünderkamp, 1997).

With the increasing number of connections to the Internet, network security is a growing concern in schools. The frequency and severity of violence in primary and secondary schools is best documented by the attention this topic has gained in the media. Bearing this in mind, the national and international attempts to enrich the education at an early stage with networked computer-based information technology are a mixed blessing. On the one hand, programs promoting the connection of schools to the Internet are necessary and desirable to keep up with today's technical reality. Information on the Internet and connections to the Internet are no longer confined to specialised fields. On the other hand, the potential for misusing the Internet is becoming more and more apparent (Lüssem & Spalka, 1997).

Although the connection to the Internet can, in some cases, cause many security problems, additional jobs for system administrators are not planned. Consequently, more and more teachers have to deal with the tasks of a system administrator, i.e., they are responsible for the security of computer networks in schools. But only a few of the teachers responsible for the development of secure school-networks are experts in this field (Knaak, Lüssem, & Spalka, 1997). As we have found in a recent survey, often these teachers cannot sensitise their colleagues to security issues (see Figure1).

This leads us to two interdependent kinds of measures. Thus, security policies must be developed that are easy to understand, as well as effective. And, additional computer security training should be integrated into teacher training.

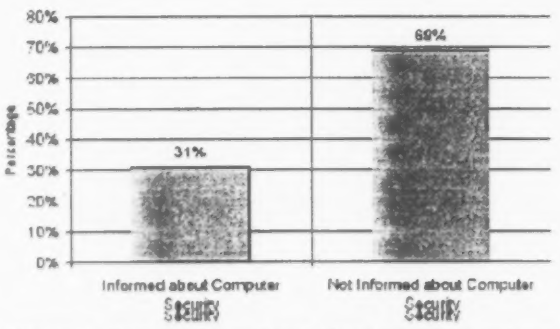

Figure 1. Result of a survey: How many teachers are informed about computer security.

The Threats

First we give some examples of the situation at schools by presenting two possible scenarios.

Scenario One

Suppose e-mail has become an indispensable part of the foreign language lessons in school A, for which contact to foreign schools is a new and important opportunity. Outer-school experts are consulted for advice on special problems and much of inner-school communication is done via e-mail. A breakdown of the e-mail server can be caused deliberately if a sufficiently large number of e-mails are sent to e-mail addresses of the school. This can lead to severe disturbances of the lessons.

Scenario Two

Suppose at the beginning of a new school term, the pupils of a computer course at school B are given e-mail

accounts, all of which can be entered with the same password before the pupils start to work with accounts. Many pupils do not regard changing their password as necessary because most of the data on their accounts do not seem to be worth protecting. Thus, pupils are able to break into the system using another pupils' name: a harmless example of abuse is the sending of funny e-mail under wrong names, whereas the distribution of harmful material will definitely lead to far reaching consequences.

As mentioned in the second scenario, on the Internet one can as easily publish harmful material as one has access to it. In addition to violating a state's constitution and laws for the protection of minors, many sites on the Internet endorse, if not glorify, violence of all kinds. The violation of the rights of individuals, e.g., unauthorised communication of personal data and electronic harassment, is another problem that arises. Thus, we have to deal with the following questions:

- How can these security risks be avoided or minimised?
- How can we protect the rights of individuals?
- What measures can be taken in case of security violations?
- Whom can teachers consult in such a situation?

Only integrated security policies and sufficiently trained teachers can help to answer the above questions. Only they will solve these problems and will make pupils familiar with security mechanisms they are likely to meet in the future as employees.

Until now the steps taken to protect pupils from the Internet's harmful information can be characterised at best as singular and spontaneous. There is hardly any doubt on their insufficiency. They can be subverted without much effort (often unnoticed given that the pupils' technical skills frequently exceed those of their teachers) or they obstruct the proper use of the Internet.

We are convinced that these problems will not be solved until a comprehensive concept for securing networked information systems deployed at schools is devised. It must be explicit and comprise all levels of abstraction and detail. At the top level, a security policy must state the protection demands and the responsibilities of all stakeholders. From this, a set of concrete rules and measures, technical as well as non-technical, must be derived. The most important technical component is a suitable computer security model. This security policy must accommodate both a school's organisational structure and the particularity of its computer systems. Lastly, these provisions must be supported by security measures for the operating system and the hardware. The level to which we pay the least attention is most likely to be exploited for illegal purposes.

Concepts for the connection of schools are called for that provide structures which can be adapted to the needs of the school not only by experts but even by teachers. Security mechanisms have to be integrated, user-friendly and transparent for pupils and teachers as well as sufficiently effective.

Security Concepts

First of all, we must recognise that prevalent security concepts were developed for and targeted at commercial and governmental institutions. Although there is, at present, no alternative, their applicability and effectiveness in schools is questionable. To give an example, the connection of a school computer to the Internet requires a redefinition of a protection unit. Whereas traditionally, a unit of protection must be protected from unauthorised access by users, at school, the pupil must be protected from accessing Internet pages comprising unauthorised content (Cremers, Lüssem, & Spalka, 1997).

Due to the world wide extent of the Internet, there are currently no effective preventive security mechanisms. Protection products, such as PICS (World Wide Web Consortium, 1997), rely on a co-operative behaviour of the content providers - and for their shallow resistance to subversion, on the technical ignorance of the users. In view of the problem's nature, neither one can be taken for granted.

Thus we must resort to the next lower class of restoration security measures. Here, auditing systems which monitor, record and signal specific events, play a central role. To ensure that access prohibitions are respected several steps must be taken: inform the pupils about the prohibitions, check for violations and sanction the violators. The effectiveness of this procedure depends on all links of the chain. The first and the last one obviously do not concern the computer system, but still have to be a part of a comprehensive security policy.

The final, and least satisfactory, class of security measures are those limiting an ongoing damage, e.g., intrusion detection monitors. Their effectiveness is generally subject to a real-time action of a system administrator. Due to most schools' pitiful financial situation, this full-time job is simply unaffordable. Reasonably, we can only expect the teachers to exercise vigilance.

Teacher Training

The training of the teachers in the field of computer security should be twofold. We have to create awareness among all teachers for the above-mentioned problems. Educators should not only be sufficiently informed about the risks resulting from the usage of computer networks. As they have an advisory and catalytic function with respect to the parents, they should also have a fundamental knowledge of how to deal with security problems. In addition, they have to be able to understand the underlying concepts of their school's security policy (Lüssem, & Spalka, 1997) and to establish parental control systems.

Teachers working with the Internet should regularly acquire additional skills. Apart from understanding the

concepts of the security policy, we would like to invite them to participate in the design of this policy (see figure 2). Only if teachers are involved in this process, will the security mechanisms applied at school be accepted by them (Safian, 1995). Basic knowledge of the security mechanisms is fundamental for appropriate teaching the pupils in this field.

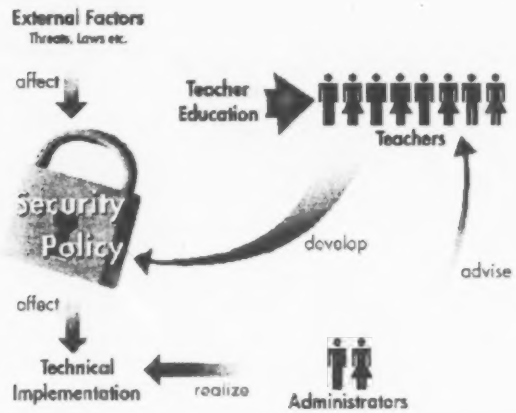

Figure 2. The role of teacher training in the process of developing a school's security policy.

Conclusion

We have shown that a school's connection to the Internet creates many new problems for which no satisfactory solutions exist. For that reason we believe that the development of a security policy targeted at the schools' requirements is a vital step. To create awareness and enhance acceptance, teachers should be involved in this process. Lastly, only appropriate training of the educators in the field of computer security minimise the problems resulting from the usage of computer networks.

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THEORY

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As the field of technology in teacher education grows, it becomes increasingly important to address the theoretical foundations of the field. For it is this theoretical foundation which gives us a sense of direction as to where we're going and why are we going there. Without a solid theoretical foundation, we cannot fully comprehend the effects of technology on teacher education, or how to implement it into our curriculums most effectively.

This year's Theory section covers the range of possibilities, from offering approaches for implementing learning theory to an overview of these theories, themselves.While the content in this area may be somewhat deeper than in some of the other areas, it is no less important and should not be overlooked by the reader as "boring" or "stuffy" for these papers are neither.

We begin with Peter Albion and Ian Gibson's look at problem based learning. They address some of the issues surrounding problem based learning, including some of the reasons why it has not been more fully adopted in teacher education. Then, they turn to their attentions to possible ways that instruction through multimedia, an activity which tends to center on the individual, can be combined with problem based learning, which tends to center on the group. By adopting some of their ideas we can change the way that teachers are taught, and have a significant impact upon the generations to come.

Next, Marino Alvarez looks at the use of an online vee diagram as a metacognitive tool. While many of us are familiar with the use of paper-based vee diagrams, Alvarez has adapted and applied this to a Web-based situation. His has developed an approach which assists students in the development of new ways of approaching and thinking about concepts, in an effort to help them to help themselves in understanding concepts, as well as in planning and carrying out research.

Nada Dabbagh takes a slightly different approach in her overview of concept mapping. Like the vee diagram, the idea is to get students to visually represent their thoughts as projects and assignments develop. Unlike Alvarez' more structured vee diagram, the computer applications, Inspiration and Semnet, addressed in Dabbagh's paper give students considerable freedom and flexibility in their approaches to a project. Dabbagh addresses the use of these programs as Mindtools which can help students look more deeply and critically information presented to them.

Charles Dickens takes us to a "middle ground" between applied and foundational theory with his look at multimodal and multiordinal communciation. He addresses the relationship between the access and creation of knowledge and the significance and meaning of the expression created. By grounding in work in the earlier works of Korzybski and Kaelin, Dickens demonstrates that the role of the instructor is influenced and shaped by theory, and the need to ground instruction in a solid theoretical foundation.

The next paper, by Steve Harlow, takes a look at what is meant by learning and knowledge, and technologies impact upon each. Harlow recognizes technology's critics and concedes that technology may not be the answer to all problems. He briefly looks at learning from both Popper and Bruner's points of views. He then postulizes how information technology might be improved by taking a more narrative view of learning as described by Schank. In a later paper, Mimi Schuttloffel looks at many of these same questions from a totally different point of view. Schuttloffel takes a more critical look at the same issues, and looks at such things as who gains by new technologies, what is lost when new technologies are adopted, what is the problem we're trying to solve with technology, and what new problems does technology create.

Hoskisson, Ritchie, Hoffman, and Roddy have prepared a panel presentation which everyone with an interest in instructional technology should be encouraged to read. They provide a very good overview of four different schools of thought: objectivist, generative, constructivist, and problem based learning. The basic tenets of each theory, as it applies to learning, is examined. More importantly, each section is followed by a short lesson plan,

designed and implemented according to the foundational beliefs of the theory under scrutiny. These lesson plans all utilize the same basic concept: teaching preservice teacher to use the Internet. By looking at this one lesson from four different points of view, Hoskisson et al. help the reader better distinguish the differences between each of the four theories. This provides a review for those who may be a little rusty in their theoretical foundations.

Gulsun Kurubacak's paper on critical thinking takes us back to application theory. By taking the stance, "When thinking critically and reflectively, we become active and productive people," Kurubacak leads us through some very convincing arguments of ways that computers could be better utilized as classroom Mindtools. As a research foundation, he describes two courses, one graduate and one undergraduate, both with strong online components in the coursework. By looking at how the online nature of assignments affected student output and performance, we begin to gain some insight as to what the future may hold as we inevitably move toward more online, distance education.

Michael Land and Mary Ann Coe take a critical look at the concept of teaching technology. They raise the issue as to why are we separating the tool (technology) from the subject matter. They point out that the tool is not the end, but the means to an end. We do not build our own automobiles, so why should we expect teachers to program their own computers. They advocate better integration of technology in the curriculum as a whole, modelling for prospective teachers ways of using technology effectively.

Avril Loveless and Michelle Selinger bring us a British perspective with their papers on pedagogy. New laws in Britain have affected the way that instructional technology is approached. Loveless and Selinger describe programs at the University of Brighton and Warwick University, respectively, and how these programs have been impacted and, in turn, influenced the pedagogical foundations of teacher education in Britain.

Finally, Cameron White takes a critical look at the role of technology in teacher education. He addresses the issues of empowerment and access. Can technology really empower the disenfranchised? Or, does it simply widen the gap between the haves and the have nots. As we move from a modern to postmodern age, how to do transform education, in particular teacher education, to enfranchise both students and teachers. Part of teacher education should be helping teachers develop an awareness of the issues of access and equity and how technology can be used to improve the status quo.

As you can see, there is a wide range of philosophies presented in this year's Theory section. While most of the papers do focus on application theory, there is enough foundational theory presented to give a broad overview of those theories most popular in teacher education today. We can take this theoretical foundation and apply it to issues that are encountered throughout teacher education, and, more importantly, they can be used to help ensure that we continue to strive to reach the fullest, brightest potentials that technology offers us.

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Designing Problem-Based Learning Multimedia for Teacher Education

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In response to the advent of personal computers in schools, the energies of teacher educators have generated successive waves of activity in which they have variously sought to assist teacher education students towards computer literacy, to encourage the integration of computer software across the curriculum and to model the use of computers in their own teaching.

Students entering teacher education programs from secondary school are now likely to have been exposed to computers from their earliest years and to possess at least basic skills. Many of them expect technology to play a significant role in their educational experience. The next wave formed by the combined energies of teacher educators must be directed towards using these technologies to improve the quality of processes and outcomes in teacher education.

One component of this wave must focus on incorporating quality teaching processes into a variety of media not dependent upon face to face teaching but designed to support the increasing interest in flexible, open and distance learning options being offered by higher education institutions. These options are especially relevant to the needs of those who by reason of distance or work commitments cannot readily attend classes and who seek access to opportunities for professional development or to new careers. Moreover, the same flexible options are relevant to the needs of students in traditional face to face courses who seek a richer range of learning experiences amidst demands placed on their time by family and other commitments. In the face of these developments students today are developing attitudes and skills relevant for a lifetime of learning.

One educational approach which has gathered momentum because of its relevance to these trends is Problem Based Learning (PBL). PBL has been adopted for the preparation of professionals in fields as diverse as medicine, engineering, law and business. Its characteristic focus on the presentation of authentic problems as the starting point for learning has resulted in a measurable increase in the motivation of students and in their ability to integrate knowledge from foundation disciplines in pursuit of a solution.

This paper describes the design and preliminary evaluation of an interactive multimedia package based upon PBL principles and intended to develop the capacity of beginning teachers to solve problems inherent in integrating technology into their teaching. The package is an outgrowth of successive developments within a teacher education course which has incorporated a problem based learning approach to solving a variety of problems contained within realistic teaching scenarios.

Learning to teach with technology

Although computers are now widely available in schools, their educational impact has been limited. Only a small proportion of teachers actively integrate information technology in their teaching (Plomp & Pelgrum, 1993) and it has been estimated that as few as 3% could be regarded as exemplary in their use of computers for teaching (Becker, 1994). According to US and Australian studies of experienced computer-using teachers (Hadley & Sheingold, 1993; Sherwood, 1993), the principal barriers to computer use include limited access to computer hardware and software, perceived inadequacies in training, lack of support and lack of time for preparation.

Contrary to expectations, newly graduating teachers may be no better prepared for technology integration than their experienced colleagues. Fewer than 25% of graduates from US institutions considered themselves "adequately to thoroughly" prepared for using computers in instruction (Handler, 1993) and Western Australian beginning teachers rated themselves lower than experienced colleagues on computer usage (Oliver, 1993). Studies of computer use by preservice teachers (Albion, 1996; Downes, 1993) suggest that, despite positive dispositions toward computer use, they lack confidence in their ability to integrate technology in their teaching.

If teachers are to be successful at integrating technology, it will not be sufficient for them to develop the capacity for confident personal use of computers. They will also require an understanding of how to adapt curriculum and pedagogy to incorporate technology and it is this dimension which presents the greater challenge to teacher education programs.

Support from like-minded peers is a significant factor in the development of teachers who succeed in integrating technology (Becker, 1994) and teachers value opportunities to share the experience of colleagues who have succeeded with computers (Sherwood, 1993). This evidence suggests that examples of effective practice with technologies may assist teachers to acquire the insights which will enable them to adapt their own practice.

Learning and reasoning from examples are important components in the development of expertise (Chi & Bassok, 1989; Dreyfus & Dreyfus, 1986) especially in ill-structured domains (Spiro, Feltovich, Jacobson, & Coulson, 1991) where problems are ill-defined and there may be no single solution. Teaching exhibits these characteristics, and there is interest in examples or cases as a means of expressing knowledge in the field and as an integral component of teacher education (Carter & Unklesbay, 1989).

The importance of teacher educators providing examples of technology use through modelling has been noted elsewhere (Parker, 1997; Zachariades & Roberts, 1995). However, even if such modelling were practised widely and well, it would still be beneficial for students to encounter examples of good practice in contexts similar to their future employment. Field experience is the logical venue for such examples but it is difficult to ensure that students are exposed to uniformly good examples. Approaches which ensure that all student teachers have access to suitable exemplars are required.

Problem Based Learning

Problem-based learning (PBL) developed in response to concerns that the academic discipline focus of a conventional university education might not be the most effective preparation for future professionals. Since originating in North American medical schools in the 1950s PBL has spread to many countries and fields of professional education (Boud & Feletti, 1991).

According to Boud (1985), a PBL encounter typically begins with an authentic problem of practice without any prior preparation by students. Following initial analysis of the problem which is usually undertaken in a small group, areas of learning are identified for individual study and the knowledge and skills acquired in this way are applied back to the problem. The final reflective phase provides opportunity to summarize what has been learned, and to integrate it with the student's prior knowledge. Among the advantages claimed are increased motivation and better integration of knowledge across disciplines.

A variation has been described by Gibson and Gibson (1995) in the context of teacher education. Students were initially presented with a one page printed scenario describing a situation typical of the beginning years of teaching and required to analyse the scenario and develop three alternative plans for action with projections of the likely consequences of each. During face to face tutorial sessions following the generation of individual written responses, students were involved in a variety of group processes designed to increase the benefit of interaction with colleagues in the context of seeking solutions to the problem.

In focusing on the solution of authentic problems as a context for acquiring a range of relevant knowledge, PBL methodology accords well with the theories of expertise proposed by Dreyfus and Dreyfus (1986). They argued that the performance of experts tends to be characterised by non-propositional knowledge and proposed that skill acquisition at and beyond the third of the five stages they identified in their description of the development of expertise may be best served by construction of sequences of situational case studies. Such cases ought to include rich contextual information and should engage students in discussion and interpretation based on experience of previous cases.

Compared to other professions, PBL appears to have had relatively little impact on teacher education. Chappell and Hager (1995) reported that although "professional courses around the world, including nursing, design, engineering, optometry, architecture, law and business" were using problem-based approaches they were aware of no instance where this was occurring in teacher education. Although limited implementations of problem-based learning in specific components of teacher education courses have been reported (Gibson & Gibson, 1995; Ritchie, Norris, & Chestnutt, 1995), as yet there appear to be no instances of wider application to an entire course.

It is not clear why PBL has been less widely adopted in teacher education than in other professional courses. One explanation is that case-based approaches to teacher education (Shulman, 1992) are meeting the needs of teacher education programs for relating professional preparation to the experience of practitioners. However, problem-based learning should not be confused with case methods (Bridges, 1992) and deserves to be considered for the unique contribution that it might make to the professional education of teachers.

PBL and Multimedia

Hoffman and Ritchie (1997) found no published articles describing how multimedia might address problems with the delivery of PBL courses. In their view, the key benefits of multimedia in PBL would include fidelity, representational richness, time and timeliness,

individualisation, assessment, efficiency and increased power of agency.

A variety of other approaches to using computers to facilitate and enrich the experience of PBL have been described and at least two (Mackenzie, Kitto, Griffiths, Bauer, & Pesek, 1997; Ronteltap & Eurelings, 1997) include provision for supporting collaborative problem solving in distance or flexible learning modes.

In contrast to PBL, interactive multimedia is most often viewed as a technology which promotes opportunities for individual rather than group learning and it may be this aspect which has mitigated against its adoption for PBL. However, many professionals, including teachers, find that much of their work is performed in circumstances where they are required to act alone. Multimedia produced with a PBL approach may offer opportunities for students to engage in individual work both in traditional courses and in flexible or distance mode.

It is against this background that the project described in this paper was developed in response to the need of beginning teachers to "experience" the challenges associated with integrating technology into their teaching and to obtain access to exemplars of appropriate practice.

Project background

Over the past several years, the final unit in curriculum planning taken by University of Southern Queensland students preparing to be primary school teachers has used a problem based learning approach to heighten students' appreciation of the realities of practice. Early iterations of the unit introduced print based scenarios in which students are presented with a teaching problem which might be encountered during the first years of teaching. Students are required to clarify the problem and to prepare three possible solutions for the problem, giving due regard to professional and ethical issues and to relevant educational theory.

During 1994, interactive television was introduced to afford students the opportunity to observe and interact with teachers on remote sites (Gibson & Gibson, 1995). By linking the interactive sessions with the problem based scenarios, students were able to gain a deeper appreciation of the realities of teachers' work. Students especially valued the opportunity to observe teachers and to hear their comments on the teaching process.

Designing PBL Multimedia

Interactive television sessions present significant logistical challenges, and, despite their popularity and evident success with students, it is doubtful that funding would permit their use on a routine basis. Videotapes of the sessions were made for use in subsequent years, but video does not offer the same opportunity for engagement as was available to the original group of students.

The multimedia CD-ROM project arose from a desire to present students with video and other materials in a framework which would support engagement through direct interaction rather than passive viewing. Prior success with PBL approaches in the context of the unit led to speculation about the possibilities of merging multimedia and PBL to maximise the benefits of both.

The design of interactive multimedia based on PBL principles presents particular challenges in that, while the nature of interactive multimedia encourages individual use, PBL most commonly involves groups of learners interacting. In bringing these two threads together it was necessary to preserve the essential characteristics which lend each its peculiar efficacy.

Development of the design model and the way in which the different modes of operation of interactive multimedia and PBL were reconciled has been described in detail elsewhere (Albion & Gibson, forthcoming). Briefly, there is evidence (De Grave, Boshuizen, & Schmidt, 1996) that a significant role of the group interaction in PBL is to effect conceptual change through cognitive dissonance, and the design intent in the multimedia product is to use examples prepared by a panel of experienced teachers to challenge the initial ideas of the user.

Users of the CD-ROM are invited to play the role of a teacher in a succession of situations, each of which presents a problem related to planning for the integration of technology into teaching. Each problem begins with an activation task in which the user prepares a brief statement relevant to an employment selection criterion. A series of planning tasks follows and the problem concludes with a final task designed to encourage reflection and integration of what has been learned. As each task is completed users have opportunity to compare their response with the responses prepared by a panel of experienced teachers.

A teachers desk equipped with, among other things, a laptop computer, notebook and resource materials is used to provide a consistent interface throughout the problems. In addition to the responses from the teacher panellists, users have access to a variety of documents based on those found in schools, demographic data about classes, web sites and video interviews with technology using teachers.

Evaluation

The original plan for formative evaluation of the CD-ROM anticipated that a group of final year teacher education students (n = 30) would have up to four hours in which to interact with a complete working version of the first of the four problems envisaged for the package. The software was to include the problem scenario and associated tasks together with a variety of relevant resources and model responses from a panel of teachers.

Delays in the development schedule and the other commitments of students beyond the originally scheduled evaluation dates resulted in a smaller group of students (n = 14) having no more than 2 hours to interact with a very

early prototype of the software. Nevertheless, it was decided to proceed with the evaluation in the expectation that it would provide useful data to for the development process.

Despite the difficulties of working with an incomplete version of the software the reaction from students was strongly positive. On a 5 point scale indicating agreement with a series of statements they recorded an average score greater than 4 for statements about the relevance of the software to the work of teachers and about improving their capacity to integrate technology into teaching.

Students reported that they had gained fresh insights into aspects of teaching referenced in the materials they used, including physical arrangements of classrooms (13 responses), teachers' knowledge of technology (12), teachers' self organisation (12) and classroom management (10). Several commented favourably on the video interviews with teachers talking about their experience with integrating technology and on the inclusion in the software of a segment which permitted direct manipulation of graphic elements to simulate placement of furnishings in a classroom.

Unfavourable comments were generally restricted to interface issues which were mostly associated with the developmental state of the prototype at the time of testing.

Although limited by the developmental stage of the prototype and the small number of students involved, the preliminary evaluation tends to confirm the general direction of development in this project. Students evidently see value in accessing examples of good practice by teachers and report learning from it. Based on the favorable responses of students to the graphical manipulation of the classroom plan, additional exercises using different layouts will be included in the final version and a similar manipulative approach will be used for timetable planning.

Comments from students were also applied to refining the user interface and making the flow of the problem more readily apparent to the user. Based on their comments changes were made to provide more explicit directions at points where responses were required and to permit easier access to the variety of resources available on the CD-ROM.

Conclusion

The folk wisdom of teacher education asserts that "teachers teach as they were taught". Clearly this cannot be absolutely and universally true else there would be no development in teaching approaches over time. However, there is sufficient truth in the statement to impose an obligation on teacher educators to ensure that their approaches to teaching, including the use of technology, provide examples of practices worthy of emulation.

Synergistic combinations of effective approaches to teaching with new media have the potential to enhance the learning opportunities for teacher education students both directly through their combined power and indirectly as examples of good practice. Results from the preliminary evaluation of this interactive multimedia CD-ROM based on problem based learning principles indicate that this may be one of the combinations which will contribute to the next wave of improvement in the preparation of future teachers for teaching with technology.

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Interactive Vee Diagrams as a Metacognitive Tool for Learning

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Technology is influencing the ways in which students are using metacognitive tools for learning. Changing paper-and-pencil modes of communicating in favor of electronic interactions that are more efficient and foster collaborative dialogues. Teachers and students are using the Internet not only to access information, but also to show creative compositions and share reports (Alvarez, 1996). An innovative use of one such metacognitive tool for students to self-monitor their learning is the development of the *Interactive Vee Diagram*. This tool is an electronic version of present uses of vee diagrams that are used either as a teaching tool to clarify concepts, evaluate documents, or to plan, carry out and finalize research investigations. This paper focuses on two of its uses: as a way to evaluate documents, and as a tool to plan, carry out, and finalize research investigations.

Much school learning consists of rote memorization of facts with little emphasis on meaningful interpretations. For example, students are often asked to solve scientific problems and conduct laboratory experiments in a rote rather than in a meaningful way (Novak, 1988, 1990). Often scientific knowledge is assumed to be absolute and students are viewed as passive recipients of information (Driver & Oldham, 1986). In such instances, reading assignments are given, lessons are reviewed, and question-answering is equated with producing "right" answers. Under these circumstances, knowledge construction is reduced to factual knowledge production with little regard for critical thinking, problem solving, or clarifying misconceptions. Texts are often written to support acquisition of factual knowledge. The language of the textbook or laboratory manual is often vague with ill-defined concepts, or with lists of facts that are not situated in a context that encourages students to relate new concepts to their prior knowledge. Seldom are these facts related to students' everyday experiences, or to other disciplines (Donham, 1949; Erickson, 1984; Eylon & Linn, 1988; Sarason, 1990). Further, Novak, Gowin, and Johansen (1983) show that students lack or misconstrue links between text concepts resulting in a failure to assimilate and accommodate new knowledge in their cognitive structure.

Gowin's theory of educating (1981) focuses on the educative event and its related concepts and facts. This theory is helpful in classifying the relevant aspects of the educative event. In an educative event, teachers and learners share meanings and feelings so as to bring about a change in the human experience. This theory stresses the centrality of the learner's experience in educating. Recently, strategies have been reported in which students are active in constructing their own concepts (e.g., Driver & Oldham, 1986; Fosnot, 1989; Pines & West, 1986).

Vee Diagrams

The Vee heuristic was developed by Gowin (1981) to enable students to understand the structure of knowledge (e.g., relational networks, hierarchies, combinations) and to understand the process of knowledge construction. Gowin's fundamental assumption is that knowledge is not absolute, but rather it is dependent upon the concepts, theories, and methodologies by which we view the world. To learn meaningfully, individuals relate new knowledge to relevant concepts and propositions they already know. The Vee diagram aids students in this linking process by acting as a metacognitive tool that requires students to make explicit connections between previously learned and newly acquired information. TheVee diagram is shaped like a "V" and elements are arrayed around it. The left side, conceptual or thinking side, of the Vee displays *world view*, *philosophy*, *theory*, and *concepts*. The right side, methodological or doing side, has *value claims*, *knowledge claims*, *transformations*, and *records*. *Events and/or objects* are at the point of the Vee. Both sides are interactive; not exclusive (see Gowin, 1981; Novak & Gowin, 1984; Explorers of the Universe: http://coe2.tsuniv.edu/explorers).

The need for instructional tools, such as the Vee diagram, to enhance conceptual learning has been stressed by Novak (1990). In a study with seventh and eighth graders, Novak, Gowin, and Johansen (1983) found that students could understand and use Vee diagrams in science

classrooms, and that science teachers could use this strategy as a part of their everyday teaching/learning practice. The results of their findings, as well as others (e.g., Alvarez, 1987; Alvarez & Risko, 1987; Alvarez, Risko, Waddell, Drake, & Patterson, 1988; Gurley, 1982; Leahy, 1986; Taylor, 1985), suggest that Vee diagrams can aid students by focusing on the salient role of concepts in learning.

While the aforementioned studies used the Vee in the conventional paper-and-pencil format, this was the first attempt to design and use an *Interactive Vee Diagram* electronically on the Internet. The research question was "Do Interactive Vee Diagrams appearing on the Internet aid college graduate students in analyzing research documents, and in planning research investigations?" The purpose of this paper is to demonstrate how an *Interactive Vee Diagram* is used by college graduate students in two ways: first, to evaluate documents, and second to plan their research investigations.

Method

Twenty-nine college graduate students enrolled in an Educational Research class taught by the author, who was the teacher/researcher, participated in this study. The *Interactive Vee Diagram* was developed for the Internet by the researcher and represented the first time a Vee Diagram has been used interactively and electronically.

A Web site was established for the research class, and was placed on a Web server (Alvarez, 1977a, 1977b; 1977c, 1977d; 1995; Alvarez & Rodriguez, 1995). To insure confidentiality and outside tampering, a password was given to the class of students for access.

Interactive Vee Diagrams

The shape of the Interactive Vee Diagram appearing on the Web site was the same as the one advocated by Gowin (1981). The elements arrayed on the Vee were identical to those that appeared on the paper version. The only addition was a space for students to either write suggestions or problems they may be encountering in their analysis of their research article or the planning of their research study. The *Interactive Vee Diagram* on the Internet is menu driven and asks for the students for their name, school address, and e-mail address. Also included are instructions for entering information on the Vee. Other features include a link to a paper on the uses of a vee and an action research plan, both written by the researcher, a visual of a Vee with explanations of the epistemic elements, a movie clip of a student discussing his Vee with the teacher, and an animation of the components of the Vee. There is also a share folder compiled by this researcher by which information of a general nature can be accessed by teachers and students. Clicking on the respective field of the arrayed elements enters data. Once the fields on the Vee template have been completed, the student can review the entries and then electronically submits the information to our base site. There is also a space for students to type suggestions or problems they may be encountering in their study for submission (see Figure 1).

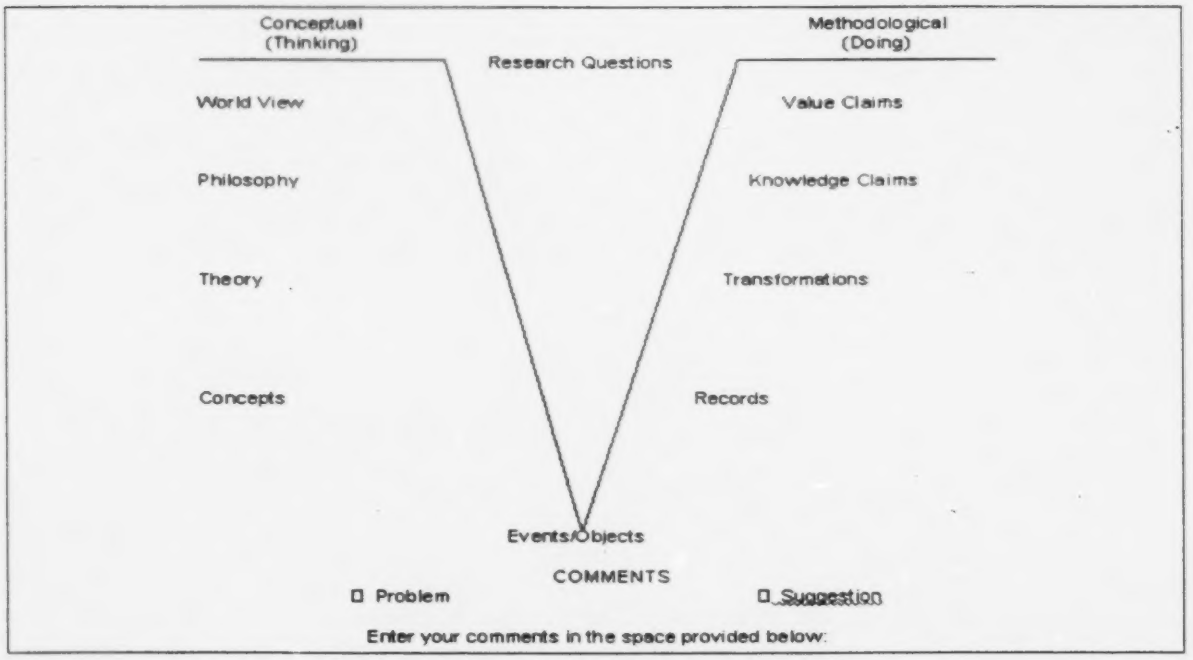

Figure 1. Interactive Vee Diagram Template.

The graduate class was given the assignment of developing individual Action Research Plans on a topic of interest in their teaching field and/or major area of concentration. These students used the *Interactive Vee Diagram* in two ways: (1) to Alay the vee@ on a research article they self-selected for analysis; and, (2) to plan their Action Research Study. Each Vee was electronically transmitted via the Internet; analyzed by the professor (the researcher). Feedback was provided through the same medium. A database was established that tabulated each of the elements on the Vee for comparison and extent of rethinking of ideas that occurred for each transmission and revision. In this instance, two measures were taken for each way the Vee was used: interpreting a research article; planning their individual Action Research Study.

The researcher trained the students in using the Vee. Students were shown examples of Vee diagrams constructed by paper-and-pencil. A skeletal Vee diagram that contained these headings: *focus or research question event/ object, concepts* to be investigated, *world view, philosophy, records, transformations, knowledge claims, value claims, theory*, and *principles* appeared on the Internet. These terms were explained and demonstrated with examples for their meaning. They used Gowin's (1981) Q-5 Technique as a questioning strategy to guide students' notations on their Vee diagram. These questions comprised the Q-5 Technique: (1) What is the telling question? What does it tell *on* or is about?; (2) What concepts are needed to ask the question?; (3) What methods/procedures are useful in answering the question(s)?; (4) What answers are produced?; and, (5) What value do these claims have? The purpose of these questions is to guide the learner's inquiry of a topic under study by focusing attention to the components arrayed around the Vee. Scoring procedures of student Vee diagrams followed the protocol suggested by Novak and Gowin (1984). Individual Vee diagrams were scored on a quality point scale (0-4) with a maximum score being 18 using the following criteria (point values in parentheses for each of the categories): focus question (0-3), objects/events (0-3), theory, principles, and concepts (0-4), records/transformations (0-4), and knowledge claims (0-4).

Findings

Initially, most of the students had difficulty entering their information of their analysis of the research article into the electronic format. Many of these students were not familiar with using the Internet for interactive communications, such as e-mail. Additionally, the inputting of information on the Vee for submission electronically was a first attempt at using this heuristic. We also experienced some difficulty receiving their analyses due to transmitting difficulties. However, once these transmission complications were resolved, the students entered their analyses and they were received and coded in our data bank. Each individual Vee diagram was reviewed and students were given feedback.

When Vees were used in the planning of their Action Research Plan, students again monitored their understanding with their chosen topic by completing its preliminary elements. Students completed their Research Questions, Events, Concepts, Records, Theory, World View, Philosophy, and how they planned to Transform the data. As a metacognitive tool the Vee diagram aided students in monitoring the concepts, events, and facts needed to answer their focus or research question(s). These elements, combined with the other components arrayed on the Vee, were revisited by students during the planning of their investigation and enabled them to search their prior knowledge of the targeted concept under study and extend this knowledge through the formulation of graphs, hierarchical concept maps, knowledge and value claims, and by linking principles to a plausible theory. Conceptual understanding of the targeted concept was also enhanced by conversations emanating with other members of the class and the teacher as their investigations progressed. These cooperative inquiries and resolutions were achieved under the guidance of their teacher who facilitated this exchange of ideas.

Conclusion

Vee diagramming is a way to help students penetrate the structure of knowledge they seek to understand. Being able to get the "right" answer is sufficient in many school evaluations, and too often only rote recall is needed to answer questions. Teachers when versed in Vee diagramming seem to be receptive to this learning strategy in order to achieve meaningful rather than rote verbatim learning, and see this strategy as an independent learning aid to be used by the student (Novak, 1990; Novak & Gowin, 1984; Novak, Gowin, & Johansen, 1983). Involving students in collaborative thought using Interactive Vee Diagrams on the Internet institutes meaningful conceptual change in the ways in which knowledge is viewed.

A conceptual change approach to teaching should include explicit ways for students to become aware of their own beliefs and to come to understand the nature and construction of knowledge (Bransford & Nitsch, 1985; Brown, 1975; Fosnot, 1989; Siegel, 1988). Interactive Vee Diagrams that are shared on the Internet provide the learner with this type of a metacognitive tool by which facts and ideas can be learned meaningfully through reflective thought. This study indicates that online *Interactive Vee Diagrams* are increasing student awareness and knowledge of research practices, and allowing them to share and communicate their findings with others in ways that are meaningful and noteworthy. These interactive communications and rethinking of ideas resulting from collaborative meaning-making with the Vees are aiding students and teachers in mutually understanding conceptual relations in a meaningful forum.

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Enhancing Critical Thinking Skills through Concept Mapping

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Knowledge representation refers to how we represent information in long-term and working memory (Gagne, Yekovich, & Yekovich, 1993). Knowledge representation can take many forms (mental representations) depending on the type of knowledge learned and the cognitive strategy used in acquiring that knowledge. For example declarative knowledge which is best described as "knowing*that* something is the case" (Gagne, Yekovich, & Yekovich, 1993) is represented in the form of propositions. Propositions are knowledge units often referred to as schema (Jonassen, 1988). A schema is a *propositionalnetwork* that is comprised of arguments (topics and attributes) and relations that constrain those arguments (Gagne, Yekovich, & Yekovich, 1993).

For example our schema for "school" is comprised of arguments such as teachers, students, classes, grades, classrooms, and books and relations that constrain those arguments such as "teachers teach students", "students learn from teachers", and "grades measure students' performance". Procedural knowledge on the other hand is "knowing *how* to do something" and is represented in the form of productions or IF-THEN contingency statements:

If figure is two-dimensional
and figure is three-sided
and figure is closed
Then
classify figure as "triangle".

Productions are condition-action rules that enable people to solve problems, make decisions, and develop plans (Gagne, Yekovich, & Yekovich, 1993; Jonassen, 1988). In other words they "produce" an action or a mental or physical behavior. Productions can be interrelated to form a production system which can lead to a complex behavior. Developing production systems for different types of knowledge enhances inference-making and critical thinking skills.

Declarative knowledge and procedural knowledge are interdependent (Jonassen, 1996). Although one might think that acquiring propositional knowledge is a prerequisite for forming productions, in some cases acquiring procedural knowledge can lead to the acquisition of declarative knowledge and *applying* declarative knowledge can lead to the acquisition of production systems. The interdependence of those two types of knowledge is largely dependent on the cognitive (or metacognitive) strategy that the learner is using while acquiring the knowledge. Concept mapping is a mindtool (a computer application that engages the mind in critical thinking) that can enhance the interdependence of declarative and procedural knowledge to produce yet another form of knowledge representation known as *structural knowledge* (Jonassen, 1996). Structural knowledge is best described as "knowing*why* something is the case". It helps learners integrate and interrelate declarative knowledge and procedural knowledge by activating the perceived static nature of declarative knowledge and by increasing the awareness of*why* one knows*how* to do something. Concept mapping requires that students think about a knowledge domain in meaningful ways in order to represent what they know (Jonassen, 1996). By using this computer tool as a cognitive or learning strategy, learners can sharpen inference-making and critical thinking skills and can avoid the acquisition and accumulation of inert (unusable) knowledge.

Computer-based Concept Mapping Tools

Inspiration and Semnet are computer-based visual thinking environments that allow users to create concept maps (also known as semantic networks or nets), webs, outlines, graphic organizers and much more. They are easy-to-use and multi-platform. The basic elements of concept mapping software are*nodes* and *links*. Learners use nodes to represent ideas and links to represent relationships that connect ideas. Applying these elements to our earlier example of the schema for the concept "school"*students* and *teachers* would each be a node in the concept map and *students learn from teachers*would be a link. As the nodes

and links become interrelated, a structural knowledge representation emerges paving the way for a meaningful understanding of the knowledge domain depicted. In order to build a concept map, the learner must interact with the knowledge domain and organize the information so that it is personally relevant. Prior knowledge and experience play an important role in this learning task ultimately creating a reorganization of existing schemata into a new knowledge structure that is useful and pertinent.

The main advantage to the development of computer-based concept mapping tools such as Inspiration and Semnet is that they remove the drudgery and mess of revising paper-based concept maps (Anderson-Inman & Zeitz, 1993). Electronic concept maps can be modified dynamically and this makes it possible for learners to reflect their improved understanding of a content domain over time by making revisions to their concept maps quickly and easily. Those revisions can also be guided by teachers which renders concept mapping effective as a means of assessing student learning (Sonak, McClure, & Suen, 1995). Electronic concept maps can also be used as planning tools to organize a project or a learning activity.

Inspiration supports the following learning strategies: Outlining, Webbing, Planning, Organizing, Writing, Knowledge mapping, Brainstorming, and Concept mapping.

It is evident from the above functions of this mindtool that its classroom uses are extensive. Students can use this mindtool as a learning strategy to identify important concepts of a content domain and the interrelationships amongst those concepts. This process serves the same purpose as outlining a chapter but requires a more thorough analysis of the content (Jonassen, 1996). Students are engaged in generating a semantic network (concept map) that mirrors their understanding of the content under study. This spacial representation of ideas and relationships becomes a scaffold for acquiring new knowledge (Spoehr, 1994). When used as a pre-instruction exercise, concept mapping allows teachers to inspect students' knowledge structures to identify misconceptions and therefore adapt instruction to facilitate learning (Sonak, McClure, & Suen, 1995). Students can also use this mindtool as an organizer to plan a research paper or a group project.

Technique

When you first run Inspiration, it opens to an *untitled* diagramming window with a *main idea symbol* in the middle of the window awaiting the user's input. A *main menu* and a *tool palette* also appear. You begin by typing your main idea (concept) or any idea in the highlighted area inside the symbol. If your ideas are unconnected and you are in the process of brainstorming a topic or a learning task, you continue by pointing and clicking anywhere in the grid area of the open window to create new symbols and type more ideas in these symbols, one idea per symbol.

When you are ready to link ideas or organize them in a specific order, you use the *drawing links* feature. Simply, highlight the symbol you wish to link, and click and drag one of its diamond-shaped handles until you grab the symbol that you wish to link to. A line will be drawn between the two symbols hence linking those two ideas. You can control the direction of the link by adding directional arrows to the line using the tool palette. You can also type in *relationships* between ideas, as you become more familiar with your topic and the ideas/concepts constituting your topic. To indicate a relationship between two ideas/concepts, select the link (line) and type the text of the relationship in the rectangle that appears. When you are done typing and you hit enter, the rectangle will disappear and the text indicating the relationship remains. The following diagram illustrates the above events.

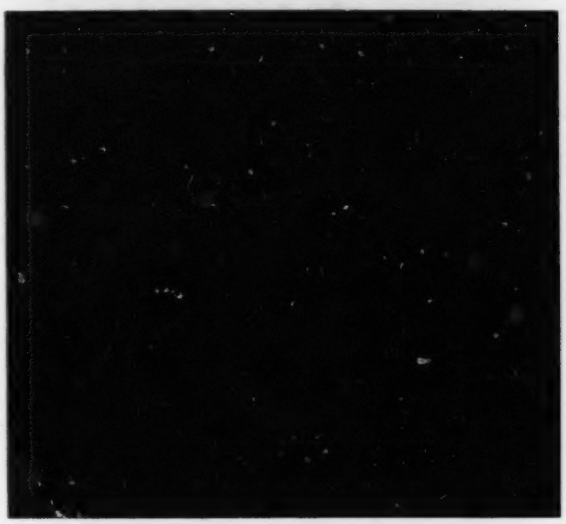

Figure 1. Courtesy http://www.inspiration.com

Inspiration also has a *rapid fire* feature that allows users to get down their ideas as fast as they can think of them without having to create symbols each time. After typing in the first idea/concept in the main symbol, press the F9 key and type in the next idea in the same symbol. The F9 key generates a marker in the form of a small red box that separates ideas. If you press the F9 key after every *new* idea, Inspiration will automatically break down those ideas into separate symbols with links in between.

Another important feature is the outline view. At any time during the creation of your concept map you can select this view from the main menu and view your concept map in outline format. The outline view provides a hierarchical structure of the concept map based on your links. You can use this view to add new topics, insert subtopics, and arrange priorities and organizational structure. You can also type notes in outline view under

each topic or subtopic to help convert your outline into a document. Everything you do in *outline view* is reflected in your *diagram view* and vice versa. The following diagram is a story web of the book *The Secret Garden* created in Inspiration:

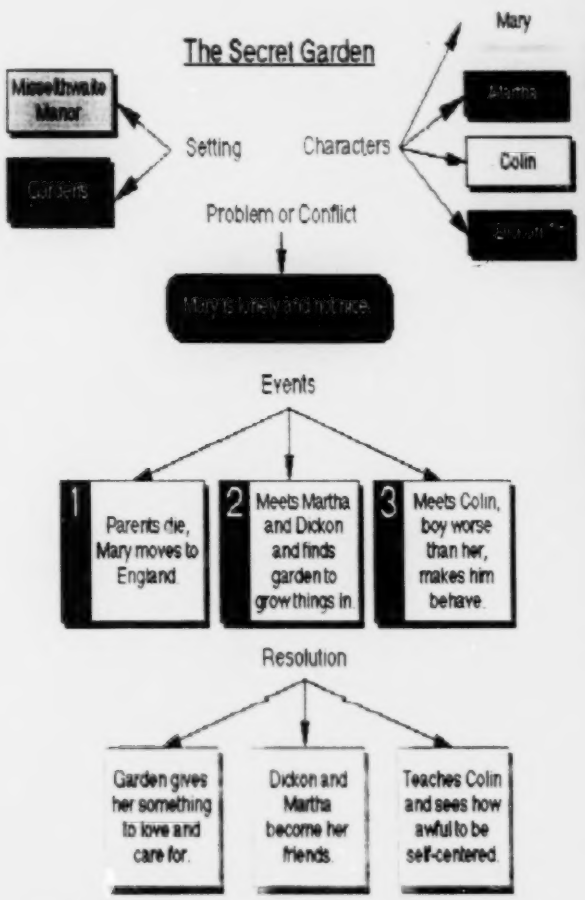

Figure 2. Courtesy http://www.inspiration.com

Below is the outline view of *The Secret Garden* story web. It was automatically created by Inspiration.

Other features of Inspiration include: Changing symbol shapes, Creating new symbols, Zooming, Flowcharting, Layering documents by creating a master (family) view and a child view.

It is not difficult to visualize the effectiveness of this concept mapping tool in facilitating student learning and teacher planning. Students can use it as a study aid to organize thoughts, create outlines, plan research papers, and examine content domains by extracting main concepts and ideas, and realizing the interconnectedness of those ideas. Teachers, on the other hand, can use this tool as a planning aid to create lesson plans, generate ideas, develop graphic organizers for content, organize curriculum plans, and adapt instruction to students' needs by monitoring students' use of concept mapping to develop key concepts of a content domain.

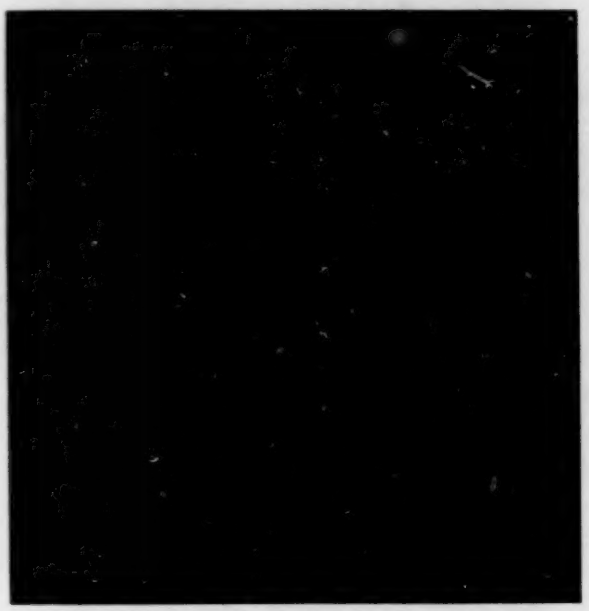

Figure 3. Courtesy http://www.inspiration.com

The other visual learning tool being investigated in this paper is Semnet. Semnet software can be used to represent knowledge domains much in the same way as Inspiration does. It allows users to organize ideas about any topic in the form of a semantic network linked by named relations. The main difference between Semnet and Inspiration is that Semnet creates a hypertext environment that allows the user to navigate between concepts through the named relations rather than providing a view of the entire concept map as is the case with Inspiration. Semnet also has additional features such as allowing the user to elaborate ideas with pictures, movies, text, charts, and sounds; and providing a continuously updated quantitative analysis of the knowledge structure being created.

Semnet supports the following learning processes:

- Collaborative thinking
- Personal organizer tool
- Study tool
- Collecting information and resources.

As a collaborative thinking tool, Semnet "can support collaborative endeavors such as curriculum development by teams of professionals or building a community of learners among students. Collaboration leads to conversation which results in clarification of ideas" (Semnet Research Group, http://apple.sdsu.edu/logan/SenNet_Collaborate.html). As a personal organizer tool, Semnet allows individuals to organize their lives and plan

their activities based on the metaphor of a clock. Users can organize their days, weeks, and years with the points of the clock and build links between and among their lives' events. Below is an example:

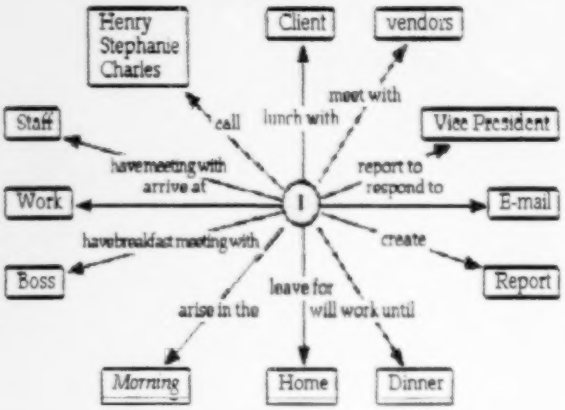

Figure 4. Courtesy http://apple.sdsu.edu/logan/SemNet_PO_Tool.html, Semnet Research Group

As a study tool, Semnet allows users to create concept maps in much the same way as Inspiration does. However Semnet emphasizes the concept-relation-concept in the construction of the knowledge map. This is based on the principle that concepts are ideas that can usually be described by a word or phrase, and that concepts can be understood through their relations to other concepts. For example, the concept dog can be understood through the word "dog" and also through its relations to other concepts:

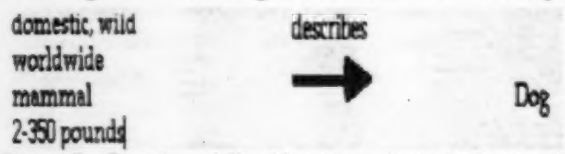

Figure5. Courtesy http://apple.sdsu.edu/logan/logan_SemMan1.html

Those relations are elaborated using the subject-verb-object, which is the basis for normal sentence construction as can be seen in the diagram below. A concept-relation-concept is known as an instance.

While students are constructing semantic networks or knowledge maps, they are actively seeking information to describe concepts by naming them and naming relationships that link two or more concepts together. In the process, they are creating an information map of their knowledge structure and this is much more useful than rote memorization. Below is an example of a semantic network (a net) created by a student about the concept *music*.

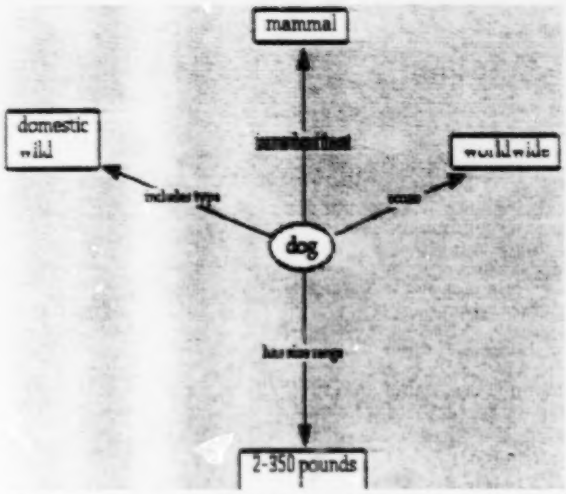

Figure 6. Courtesy http://apple.sdsu.edu/logan/logan_SemMan1.html

Figure 7. Courtesy http://apple.sdsu.edu/logan/logan_SemMan1.html

The dots appearing next to the related concepts emotion, balance, life, style, form, rhythm, melody, harmony, etc., imply that the user has created an individual net or knowledge structure fo. each of those concepts. By clicking on a related concept above, Semnet will show the user the individual net in which the related concept becomes the central or core concept.

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The last learning process that Semnet supports is collecting information and resources, in particular World Wide Web (WWW) information. It allows users to organize WWW information into an interactive multimedia database for presentations, lectures, study, research, and a myriad of other uses. This function serves as an organizational or planning tool with the added feature of being able to import and export text, graphics, pictures, and other multimedia forms from and to various applications. Individual nets (maps) can also be merged together and linked to other nets to create nets of any size (theoretically up to 32,000 instances).

Conclusion

Concept mapping is a powerful and effective instructional tool that encourages students to organize their knowledge about a content domain and to be explicit about the nature of relationships between ideas (Spoehr, 1994). Concept mapping forces students to think about the content domain in order to identify and verify important concepts, classify those concepts, describe the relationship between concepts and assess its meaning, analyze the nature of the relationship, and form the link or connection which engages the most critical thinking (Jonassen, 1996). Inspiration and Semnet are computer-based tools that facilitate this process.

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A Role for Instruction in Information Technology in Teacher Preparation

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In the broadest sense, information technology has had a role in the instruction of teachers for generations. For education, the most significant revolution in information technology prior to the current century was the advent of moveable type. The printing press made it possible to preserve and distribute information as text to the general populace and, arguably, made literacy a necessity rather than a luxury. The pervasive influence of this technology accounts for two of the three "R's" of reading, 'riting, and 'rithmetic. Today we are encountering a technology that is, at least, as pervasive and powerful as printing was centuries ago. Education, in the accepted sense of schooling," is predicated on the belief that the young must be taught to comprehend the messages embodied in technologically grounded objects of information. The pervasive information technology today is electronic and digital and requires reconsideration of what is considered appropriate schooling to achieve the goal of a literate people.

Objects of Complex Communication

Recent developments in electronic digital information technology permit the transmission of information using multiple modes of knowledge representation. Expressions of ideas, i.e., representations of knowledge, may now be communicated over a global network of digital devices (the Internet) using graphics, sound, and video in addition to textual representations. The term *multimodal* is used to characterize this feature rather than the more common multimedia. The rationale for this shift in terminology is that multimedia refers to source rather than object entities. As Korzybski (1933) asserted, "A map *is not* the territory it represents,..." Whether the source representation is text, sound, or picture, its form for electronic communication is digital and therefore a single medium.

This kind of communication is also *multiordinal.* Multiordinal terms are ambiguous and infinitely-valued, "becoming specific and one-valued only in a given context, or when the orders of abstraction are distinguished." (Korzybski, 1933) While Korzybski's descriptions were in relation to linguistics, this notion can be extended to include multimodal representations. The facility with which individual representations, in whatever mode, can be dynamically associated by linking, adds yet another order of complexity when describing the context.

Multimodality and multiordinality are the features that characterize these objects of complex communication. To participate in both the access and creation of knowledge as complex communication, it is necessary to be able to describe and interpret the structure of the total context. The multiordinality of terms in a linguistic expression requires more than a collection of definitions (which are themselves linguistic expressions) to derive the significance and meaning of the expression.

Assessing the Significance of Complex Objects

What seems to be needed is an expanded method of establishing significance in complex communications, or aesthetic communication. Kaelin (1962, 1968) develops an existentialphenomenological view of aesthetics that seems to be suited to the task. In his description of aesthetic communication, Kaelin develops a model that places artist and audience on *the same side* as the work itself. Through manipulation of materials in-the-world, the object is brought into being by the artist. Through an analogous action, the significance of the work as it embodies an expression, may be perceived, described, and judged. The communication is a dialogue between artist and audience, or creator and appreciator, which is mediated by the aesthetic object.

Kaelin (1968) develops four postulates for the interpretation of aesthetic significance, which can be paraphrased:

- All significance is context bound.
- The context is composed of counters and their relations. In the aesthetic context, these counters can be separated into surface, the direct result of the manipulation of the materials that form the object, and depth when objects are represented.

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- No counter has absolute significance. It is the relationship among counters within the context that creates significance.
- The significance of the context is the "felt expressiveness of all the counters as they fund, or come to closure in a single experience."

By the manipulations of materials (the artists medium), the expressive object is created, making it available as a phenomenal object, i.e., perceptible to the audience. In the act of perception the object then mediates in the communication process between its creator and an appreciative audience. So, too, the objects of complex communication, multimodal and multiordinal, share similar features with expressive objects created by artists, a painting, sculpture, dance, musical composition, etc.

Not all "prospective members of the artist's audience are prepared ... to participate in the aesthetic communication" (Kaelin, 1962) The critic's role in aesthetic communication, being prepared by experience and education, is to "lead the audience to the fulfillment of the aesthetic communication" (Kaelin, 1962). In analogous fashion that teachers stand in a similar position to assist students in their ability to participate in the complex communication that technology has made possible. And further, that the educational process also empower students to create their own expressions (knowledge representations) through the use of information technology.

Critic and Facilitator Roles

Kaelin's commentary on the critic's job in the context of aesthetic communication also has direct parallels in the teacher's job as a facilitator of learning in the context of complex communication, and a basis for the role of information technology in the preparation of teachers to fulfill this function.

The job of the critic, therefore, is not to state what the work of art *means;* but rather to show how it is constructed, and of what it is constructed, so that a third person may grasp its significance in an act of integral perception.... What the critic must possess is not a series of categories, which result from the classification of previous art works, but, if they can be found, the structures which are implicit in the organization of the present art work. (Kaelin 1962).

Just as a part of the preparation of the critic in Kaelin's scheme is a "sound education in the expressiveness of materials," (1962), so media education should be a part of the preparation of teachers. But education in the manipulation of materials is not enough. It should be combined with a philosophy which allows for the elaboration of appropriate criteria for making judgments about the significance of such expressions or representations of knowledge.

An Educational Technology Program

It is from this standpoint that efforts in teacher preparation, principally in graduate courses in the educational application of technology, are being directed. The Master of Education in Curriculum and Instruction at Tennessee State University added a new concentration in educational technology in the spring of 1996. The target audience for this concentration is principally teachers who have access in their school and classrooms to the information technology. The state has proven a strong commitment to the integration of technology into classroom practice, first by funding the Twenty First Century Classroom initiative, and more recently the Connect-Ten project which provides virtually every school in the state with ISDN Internet access.

Prior to the creation of this concentration, one course was offered at the graduate level for classroom applications of technology. The concentration now makes four courses available to graduate students in curriculum, and two additional, related elective courses are available from other departments. The content addressed by these courses has rapidly moved from single computer applications and evaluation of "educational" software to the creation of original projects using multimedia and hypermedia applications. It is already evident that the present program needs expansion to adequately prepare teachers. It is also evident that initial teacher preparation, which we have at both undergraduate and post baccalaureate levels at Tennessee State, incorporate more of the use of technology for information access and creation than is presently the case. New emphasis that both state guidelines and national accreditation standards are placing on the appropriate use of technology as an integral part of regular classroom practice are encouraging.

By introducing teachers to these concepts and engaging them in creating and evaluating their own efforts at complex communication, we are gradually developing a paradigm that we believe to be appropriate as the information technology continues to change. New tools have made the creation of multimodal objects more accessible. Hypermedia and Web authoring applications have taken on greater significance in our classes than was formerly the case, replacing much of the instructional time previously spent using general applications and productivity software. Time remains a significant constraint. Creating and evaluating complex objects is still a time intensive task and must be balanced against other instructional concerns. While there remains great value in more traditional approaches, this model has efficacy even when applied to less complex expressions.

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Information Technology and the Search for Coherence

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"Without stories there would be no events."
Frank Smith, *To Think*

Jerome Bruner has stated that "in certain respects, how the mind works is itself dependent upon the tools it has at its disposal." Information technology offers a variety of rapid and extensive media that engage the learner in active ways. At best, the computer places the individual in the locus of control as a learner. The learner is able to gain access to a variety of sources.

Theodore Roszak (1988) in his book *The Cult of Information* has taken dead aim at the computer as a model for the human mind and as an instrument for teaching. While his complete criticism of the computer goes beyond the scope of this essay, the gravamen of his book is that information processing loses sight of the reality that "the mind thinks with ideas, not with information." The computer is the consummate machine in dealing with the world as information. To Roszak information represents "discrete little bundles of fact, sometimes useful, sometimes trivial, but *never* the substance of thought." Postman (1996) makes a similar point in his work *Technopoly*. "Computer technology," he writes, "functions more as a new mode of transportation. It moves information—lots of it, fast and mostly in a calculating mode." Postman holds that information is both ephemeral and by nature unorganized. To both Roszak and Postman the computer is best at sorting and assembling facts. The net effect of information technology then leads to fragmented learning. That is to say, learning that does not cohere into what has been termed by Roszak and Postman "knowledge."

Roszak warns that information technology loses sight of the paramount truth that the mind thinks with ideas, not with information. "Information does not create ideas; by itself, it does not validate or invalidate them. An idea can only be generated, revised, or unseated by another idea". Information becomes the antithesis of knowledge. Roszak cautions that "an excess of information may actually crowd out ideas, leaving the mind (young minds especially) distracted by sterile, disconnected facts, lost among shapeless heaps of data."

While I hold that critics of computer technology, like Roszak and Postman, demonize information technology, and in the process lose the potential positive contribution of the computer in education, they do remind us that the mere presence and use of information technology does not in itself result in coherent knowledge. To give the critics their due, they ask advocated of information technology to address the question of what we mean by learning and knowledge. They press us to examine the effects of technology on the learning process.

In the remainder of this essay, I will briefly deal with the relationship among technology, learning, and knowing. In conclusion, I will offer an epistemology of the narrative that permits us to evaluate the effects of information technology on the educative process.

The Naive View of Epistemology

The idea that we form our notions of the world *directly* by letting them seep through our senses and mind is considered to be the position of naive epistemology. Popper (1985) referred to this view as the "bucket theory of the mind." Reality is poured into the mind by "buckets" of outside stimuli. The mind is seen as a mere receptacle of the outside world. There is an immediate correspondence between what the mind takes in and what is actually "out there." Note that there is a passivity of mind implied in this view. A further implication of naive epistemology is that the teacher's role is to lead the student more or less directly to a correct set of experiences that yield *truth*.

Novak and Gowin (1984) expose a severe weakness of naive epistemology be citing Dewey, who stated that "there is nothing on the face of a fact that tells us what it means."

In other words, facts do not announce themselves. There is a need for interpretation, background, and context.

The Constructivist View

Popper views the learner as actively testing his understanding of the outside responding world. To Popper (Hunt, 1982), "all observation is an activity with an aim." The results of such testing, to Popper, are provisional and inconclusive; the best the learner can hope for is closer and closer approximations of the way things work. Accordingly, the learner must continually acquire, and through observation and active testing, correct her understandings of the surrounding world.

Bruner's View

To Bruner, our very way of knowing is shaped by our entrance into a specific cultural milieu. Bruner goes on to state:

> When we enter human life, it is as if we walk on stage into a play whose enactment is already in progress—a play whose plot determines what parts we play and toward what denouements we may be heading. Others on stage already have a sense of what the play is about, enough of a sense to make negotiation with a newcomer possible. (1990).

Language and narrative (story) become the connective epistemological tissue from culture to the individual. In learning language, Bruner (1990) states that "the child is not learning *what* to say, but how, where, to whom, and under what circumstances." As the child develops facility in language, he begins to use language as a part of forming narrative and stories about how the world works as well as how he fits into this world. Bruner (1990) points out that there is "a readiness of predisposition to organize experience into a narrative form, into plot structures and the rest."

A View That Emphasizes the Importance of Narrative in Learning

Taking the idea of the narrative as a way of knowing, Roger Schank, a major presence in the area of artificial intelligence, holds that "story" is the major and most efficient mode of human knowledge and learning. Story is the way we encode the data of everyday life and make that data meaningful and significant. The scope of stories should be conceived in a broad fashion. Pedagogically, for example, a science experiment could assume the structure of a story. If it did *not* become a story, to Schank, it would not become a part of the knowledge base of the learner. A product of art, say a painting, can represent a story. It is not merely an aesthetically pleasing item, but translates experience into understandable narrative. Where school succeeds, it does so by stimulating the learner to construct stories, stories that embrace and fit the situation at hand. Information technology then can be assessed epistemologically by its capacity to develop stories.

Instructional technology could confer virtue to the shuffling and rapid accession of information fragments, or in its most promising form could produce coherence through discovery and resulting narratives. Information technology has the potential to assist us in the creation of narrative and story. Stories can be told by combining text, pictures, charts, graphs, sound, and video. Children can act as writers, directors, and producers in developing productions that expand simple to complex ideas in story form.

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Four Theories and Models: Underlying Assumptions and Application to Instruction

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As educators, we need to be aware of our beliefs about how people learn and we need to select tools that: are consistent with those beliefs, fit the needs of the learner, and match the purpose of the learning situation. This means that we need to have a large tool chest of models and associated strategies from which to choose. To help educators collect tools and select from them, four theories and accompanying models of instruction will be briefly explained, and a short lesson based on each model will be presented.

We have included the following four theories/models: Objectivist, Generative, Constructivist, and Problem-based learning.

Objectivist by Dale Hoskisson

Basic Assumptions

There is an objective reality which can be imperfectly known and shared with others. Reality is idiosyncratic, i.e., no two are the same, although there is enough overlap for communication and achieving mutual goals.

The elements of successful learning situations are: redundant, systematic and organized. Redundant means that there are multiple ways to learn the target material. Systematic means that everything needed for the success of the learner is planned for. Organized means the learning material is put together into an orderly, functional, structured whole.

The Model

I have chosen a generic instructional systems design model. I have chosen this because it allows me to create material based on the existence of a body of knowledge (an objective reality) that can be learned, analyzed, and shared with others in a redundant, systematic and organized way.

The purpose of instructional design is to aid the learning of the individual (Gagné, Briggs and Wager, 1992). Instructional design is a systematic, orderly but flexible approach to helping the learner that integrates all components of the learning situation and includes an analysis of the components in logical order and coordinates the overall process among those involved (Briggs, 1977).

How the Model Affects the Instructional Design of the Lesson and Choice of Technology

The learner should be actively engaged in the learning situation, not just passively listening or reading (Dick and Carey, p. 9) Learning should be placed in a meaningful context (Gagné, Briggs, and Wager p. 198) The designer should choose media that match the needs and abilities of the learner (Gagné, et al, p. 213). "This systematic method is termed instructional design. It is based on what we know about learning theories, information technology, systematic analysis, and management methods" (Kemp et al, 1994, p. 6).

Brief Description of the Lesson

The purpose of the lesson is three fold: 1) to give the students a chance to work in groups; 2) to take on at least some of the role of an actual classroom teacher and work with real children in a real classroom setting; 3) to learn how to integrate the Internet into the classroom.

The students will be divided into groups of four. Each group will be assigned a classroom teacher to work with. The goal of each group will be to produce a unit that the classroom teacher can use to teach his or her students to effectively use the Internet. The students will be given a list of suggested books. The students will have four weeks to produce the unit. The students will implement, evaluate, and revise the units before submitting them for the final grade on the project. A full description of the lesson and how it was developed using the model is included on the CD-ROM or from the author.

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Generative Learning by Donn Ritchie

Assumptions

Most educators begin at the same point. They want to create an environment in which their students will learn. But what does it mean to learn something? To some, learning is simply a biological response to external stimuli. To others, learning means constructing a personal interpretation of reality. Between these two extremes are a myriad of interpretations as to what learning involves, and how to facilitate learning.

In 1974, Marvin Whittrock proposed the idea of generative learning, which has been updated over the past quarter century, and continues to evolve as does our understanding of how people learn.

The basic assumption of generative learning is that for learning to occur, active mental participation of the learner is required. Mental connections occur as new information from the environment is integrated into existing mental structures in one of three ways. As the information from the environment is processed through the senses, learners: (a) reorganize their existing mental structures into new frameworks; (b) elaborate existing knowledge structures to become more inclusive; or (c) reconceptualize their understanding to gain a more exact or detailed understanding of the information.

Each of these three processes requires learners to actively engage in mental processing as they "create" new understandings. There are a variety of strategies that require students to actively process information to create new structures. Grabowski (1996) identifies 17 different strategies which facilitate generative learning. The groups are divided by the type of processing required by the student, with each ensuing level requiring a deeper level of processing. They all require the learner to examine new information, mentally process what is being observed, and construct (or generate) a new interpretation of the information. When students generate this new understanding, then learning occurs.

An Example

In a generative learning classroom, the instructor does not talk the entire period. When students are not actively engaged in generating new mental connections, the information is not transferred into long-term memory. If a lecture format is mandated, learning can be enhanced by activities which require active mental processing, such as generating rhetorical questions to direct and engage thought. The instructor is attuned to facilitating the learner's construction of relationships between the new information and their existing knowledge structures.

Suppose you had a group of preservice educators, who need to be taught to explore and search the World Wide Web (WWW). The instructor presents an overview of the WWW. Students take notes during the presentation, and at the conclusion they create an outline of the information presented. They write questions for the instructor, and a statement predicting how this system might be useful for educators. After a demonstration of the Web, students summarize the navigational process by creating a diagram of how pages are linked together.

Students work in teams to explore sites and materials. By synthesizing the new information with prior knowledge, students create a metaphor describing the Web. The teams exhange metaphors, and one at a time, they analyze their creations, and evaluate which metaphor they believe to be most accurate.

One class session would seldom contain each of the strategies. The selection of strategies often depends on the topics and the students' level of understanding. In this example, all of the strategies required the learner to do the generation.

Relationships to Other Theories

In the original work by Whittrock (1974a; 1974b), generative learning was shown to consist of four components. These components included: enhancing a student's motivation by selecting topics based on their interest; focusing the learning processes by using materials that pique the learner's attention; analyzing the beliefs, preconceptions, and metacognition strategies of the learner to enhance the knowledge creation process; and, helping in the generation of knowledge by establishing relationships between the environmental information and knowledge previously held by the learner. In recent years, Whittrock (1992) has focused on identifying ways to facilitate personal relationships between existing knowledge and new information.

This pedagogy can be blended into, and strengthen, other theories of instruction. For instance, in problem based learning, the role of the instructor is to facilitate learning by providing relevant, real-world problems for students to solve. The instructor can ask students to outline the information, paraphrase their solution, or create a concept map at the conclusion of the activity.

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Problem Based Learning by Bob Hoffman

Basic Assumptions

Learning is a fundamental response of organisms to their ongoing interaction with the environment. We learn continuously from before birth, and we do so in order to succeed as individual organisms, and to contribute to the success of our species.

The design of formal learning environments is as much an exercise in people's natural impetus to learn as it is focusing and magnifying their learning efforts. There is no such thing as teaching without learning. Given the pragmatic character of these assumptions, there is Problem Based Learning (PBL), which incorporates elements based on several theoretical models.

Explanation of the Model

Edwin Bridges (1992, 1995) describes the characteristics of PBL as:

> The starting point for learning is a problem
>
> The problem is one that students are apt to face as future professionals
>
> The knowledge that students are expected to acquire during their professional training is organized around problems rather than the disciplines
>
> Students, individually and collectively, assume a major responsibility for their own instruction and learning.
>
> Most of the learning occurs within the context of small groups rather than lectures (Bridges, 1992)

In terms of a cognitive theoretical rationale for using PBL, Bridges (1992) cites activation of prior knowledge, encoding specificity, and elaboration theory. PBL designers attempt to choose and sequence problems so that students apply their existing knowledge base to the acquisition of new knowledge.

Encoding specificity refers to the situation in which students will apply their new skills and knowledge. By crafting problems that closely resemble those that learners will face in the "real world", PBL strives to create a functional context that will help students transfer knowledge from the classroom into target arena.

In PBL learning environments, students actively discuss problems and potential solution strategies with each other, teach each other, and document their thinking about the problem. Each of these activities help students elaborate their knowledge.

How Might This lesson Look in a PBL Classroom?

Let's look at our sample lesson, aimed at showing future teachers how to help their students use the World Wide Web. The course instructor distributes the following to the class:

- Background materials
- Learning objectives
- Guiding questions
- The problem to be studied
- Assessment tools
- Bibliography of relevant materials

The students are divided into small groups. The task is to design a lesson to teach students how to search the World Wide Web. A learning strategy must be selected, and materials drafted to implement it. The course instructor is availabe to observe and consult with the groups.

How the Lesson Fits Learner Needs and Learning Goals

In this situation, learners need to know not only how to teach their students to search the Web, but also how to design and create effective instruction. The learning goals include not just "how-to" but "why-to". Why they would want their students to be able to search the Web, and how it might fit into their curriculum.

This PBL unit allows these pre-service teachers to experience and practice the kinds of tasks they will encounter in their profession. It provides a realistic activity in a safe environment. Their prior knowledge about instructional objectives, learning activities, lesson plan development, and assessment all contribute as they tackle this task.

PBL appears to motivate learners by giving them authority to manage their own learning to varying degrees, and by providing them opportunity to enhance their status as educators by doing what "real" educators do.

Pros and Cons

The time needed to select appropriate problems, draft objectives and guiding questions, and to gather relevant resources in PBL may be comparatively greater than preparing some other methods of instruction.

A common objection to using PBL is that, since students must spend time and energy organizing the learning process itself, they may not achieve the same grounding in basic concepts as their non-PBL counterparts

(Friedman, et al, 1992). This appears to be mitigated by improved durability of retention and somewhat better initial on-the-job performance.

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Constructivism by Mark Roddy

There is an external reality that is the basis for our experiences. This reality can be known, and meaning derived from experience can be shared with others. This is the basis for learning and teaching.

Explanation of the Model

One of the reasons that constructivism has been so widely embraced is the self-evident notion that learners "construct" their understanding as a result of experience.

For the nonconstructivist, knowledge is seen as a match between internal representations and external reality. The closer the match, the more perfect the knowledge. If we correctly sequence the right set of experiences, learners are will construct a good match between their own ideas and expert knowledge derived from external reality.

Constructivists formulate the learning process somewhat differently. They look closely at the process of perception. They acknowledge the importance of the senses as a filter between the external world and the internal representations that are constructed as a consequence of experiences. They also acknowledge that the learner interprets experiences in light of what is already known.

The Role and Nature of Sense Experiences

von Foerster (1984) begins with the assumption that we are internally driven to make sense of the world. Our brains seek order and control over the stimuli that we encounter in our experiences. He discusses the evolution and structure of nervous tissue and presents a model of the functional organization of a living organism. This organism receives sensory input, interprets this experience, and if a goal is perceived, acts in such a way as to try to achieve the goal. In so doing, it affects further sensory input and so acts upon itself. The loop is repeated until a stable sensory input is perceived.

Our contact with the external world comes to us only through our imperfect sensory experience. We cannot directly experience the world in itself. We act when we perceive a goal, when we see that something needs doing. At that point we act until an acceptable response is obtained. This constitutes our experience of the world. The physical nature of the stimuli we encounter is not encoded directly by our nervous system. This is a crucial tenet of constructivism.

The Role of Past Experiences

Perceptions are strongly influenced by past experiences. What I am prepared to "see" is greatly affected by what I have seen in the past. Experiences and expectations play an important part in the formation of our perceptions and reactions to the stimuli we encounter

Applications of Constructivism

von Glasersfeld (1987) and others (e.g. Steffe, 1983) have proposed a "teaching experiment" in which the teacher works with the student to develop a viable model of the student's understanding of the concept in question. The teacher then leads the learner through a set of experiences designed to give the learner opportunities to encounter conflicts between his or her notions and a more viable set of ideas and understandings.

Of course, such "experiments", while theoretically sound, cannot be implemented on a daily basis. In reality, what a constructivist teacher takes from this is a commitment to take into account what student bring to the classroom as a starting point, and to create a set of experiences that provide as many opportunities for the student to encounter new ideas in situations where they can be used to solve problems perceived and valued by the student.

Thompson (1985) states that the task of the constructivist curriculum developer is "to select problematic situations that provide occasions for students to think in ways that have a generative power in regard to the objectives of instruction" He advocates the use of situations in which students are encouraged to generate their own feedback with regard to a problem situation. Confrey (1987) supports this notion and gives it structure by recommending a set of questions that will help students to become autonomous problem solvers. These questions are helpful for the constructivist teacher because it helps the teacher develop a model of the student's understanding. It also puts the responsibility for the solution process back into the hands of the learner.

Conclusion

Constructivism in various forms has been embraced by many and its influence has been felt in every content area. Its full implications as a learning theory have been largely neglected. While the banner of constructivism has been invoked by many, connections between constructivism and various teaching methods have been poorly drawn. The power of this model of learning, with its emphasis on personal experience, the relationship between the learner

and the teacher, focused reflection, and communication, remains strong.

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Critical Thinking and Educational Computer Applications

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The world is rapidly changing with society becoming more technologically complex. As a result, students need to be educated differently than in the past. The educational system should prepare students to become people of this changing society, and to adapt to the changing world.

Today, critical thinking has become an increasingly important movement in the educational system, as an approach to supply students with the skills to live in the new world. Unlike traditional educational systems, the new educational system has tried to base itself on how students think, how they discover facts on their own, and how they utilize information (Halpen, 1984).

Although the idea of thinking critically is quite old, it has been extremely important for psychologists since the beginning of this century. Psychologists have tried to answer how humans think, and how to improve human thinking skills during the 1900's. However, it has only been a few years since educators have been designing educational programs based on critical thinking.

One course based on the idea of using selected instructional applications to improve students' critical thinking skills as cognitive tools is call Mindtools (Jonassen, 1996). Mindtools are intellectual partners that enhance the students' ability to think critically.

What Is Critical Thinking?

In our daily life, we can behave impulsively, so that we become unreflective and non-critical thinkers, who do not have the opportunity to improve our lives.

When thinking critically and reflectively, we become active and productive people. Critical thinking is necessary for everyone in today's dramatically changing world.

Critical thinking is the process of assessing a conclusion based on evidence (Eggen & Kauchak, 1996). It is the higher-order thinking that is the forming of conclusions. Critical thinking involves the dynamic and mental processes that are used to evaluate information, and to reach logical conclusions in meaningful and useful ways. When thinking critically, we evaluate, analyze, and connect statements, events, ideas, data, and experiences.

Scrive and Paul (1996) described critical thinking as "...the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information..." They emphasized that the information for this process was gathered from "...observation, experience, reflection, reasoning, or communication..." in our daily lives.

According to the glossary of the K-12 handbook, critical thinking is "the art of thinking about our thinking while we are thinking."

In sum, critical thinking is an intellectual process that involves higher-order skills to improve our quality of thinking based on universal intellectual values. It depends on a person's ability to think deeply, as well as the quality and quantity of experiences.

Mindtools for Critical Thinking

Using Mindtools in the learning environment will help students construct their own organization and representations. It requires students to think in meaningful ways.

On one hand, Mindtools engage students in the reflective thinking that leads to their knowledge constructions, while on the other hand, it requires external supports, such as books, slides, overheads, VCRs, computers, other people, etc.

Mindtools disagree with the idea that students are passive receptacles for the information that the teacher or instructional media impact on them (Jonassen, 1996). Mindtools are based on "constructivism" that supports students to be constructors and producers of personal knowledge. Moreover, Mindtools are not only constructivist and cognitively oriented, but they also create more intellectual responsibility in students.

Computers as Mindtools

By the 1990's, instructional computer applications and learning environments had been adapted and designed as Mindtools. Computers as Mindtools are both mental and computational devices that support, guide and extend the critical thinking process of students.

Computers as Mindtools guide students to construct their own knowledge rather than memorize the knowledge

of teachers. Thus, the process of how students construct knowledge is based on constructivism, which helps them, organize and represent what they know.

However, in the 1970's, the basic use of computers in classrooms was to apply computer-assisted instruction (CAI) that included drill and practice, tutorials, and intelligent tutors on a limited scale (Jonassen, 1996). It represented learning from computers that were programmed to teach students to direct their own activities. In the 1980's, educators were aware of the usefulness of microcomputers in the classrooms. It was believed that computers were important instructional tools.

Instructional Computer Applications as Mindtools

There are several different computer applications, like Mindtools, which can be used to improve students' critical thinking skills. Using computers as Mindtools can provide a wide variety of critical thinking situations to students in a short time. The most common computer applications, using critical thinking activities, are databases, spreadsheets, the Internet, and multimedia.

Databases and Spreadsheets

Databases are special purpose programs that are designed to meet the specific needs of a particular application or general-purpose program (Kemp, 1996). Most database programs allow students rapid retrieval of information in an independent manner. Students organize and reorganize the information to answer questions by using the database as a Mindtool. Moreover, it is the sort of function that analyzes and enters subject matter. It provides file management capabilities that allow learners to create and define new database files.

Spreadsheets are computerized, numerical, record-keeping systems that are general purpose programs for processing numerical textual data (Jonassen, 1996). They are powerful tools for solving a wide variety of problems engaging a vast array of mental processes by using and filling in values and formulas. Thus, students use existing rules, create new rules, organize information, and think more deeply when using spreadsheets.

The process of deciding when to develop a database or a spreadsheet to most improve students' critical thinking skills is difficult. Both computer applications require analytical tasks and a number of planning activities while creating and accomplishing in learning.

Barlak's (1995) and Trumpeter's (1994) research show that database and spreadsheets enable one to analyze ideas and experiments, and to come to conclusions without previously having to acquire higher-order skills.

Learners can work in groups, then collect and analyze data from various sources, create relevant questions, and prepare written reports together. This process encourages learners to use higher-order skills. Oshima's research (1996) indicates that a database system, in which learners collaboratively construct the knowledge presented to them, helps users to represent higher-order skills.

Databases can be applied to either quantitative or qualitative social sciences, sciences, or mathematics. Rooze (1986) and Russ (1986) have shown that the database is an important tool for teaching thinking and developing skills of inquiry, problem solving, and critical thinking; as well as many of the skills needed not only in school, but also life outside of school. However, spreadsheets are not very useful for social sciences. They are most useful in the quantitative areas of mathematics and sciences. Neuwirth's (1996), Kharab's (1995), Hall's (1995), and Larrieu's (1995) research show that spreadsheets can be useful tools in helping learners gain a greater understanding of mathematical structures, formulas, numerical solutions of sciences, graphical forms, and statistics.

The Internet

The Internet is the world's largest computer-based communication network (Merrill, 1996). This global communication system allows computers to share and exchange data. The Internet provides vast resources for educators to create enriched learning environments.

The Internet has the potential of offering sources, which provide up-to-date information for teachers, and instructional activities for students (Hill, 1996). The Internet offers a wide range of resources that expand and change the boundaries of school and the vast roles of the teachers and students.

Learning on the Internet is more concrete than learning by traditional instructional tools; because learners can acquire knowledge in different ways on the Internet while constructing their own learning scaffold. Students can gain unlimited information about any area in a very short time.

According to Harris (1994), the use of the Internet as a Mindtool in the classroom includes independent learning, one-on-one coaching, large group demonstration with both independent and assisted practice, hands-on labs situations.

Retrieving information is an online activity, especially for supporting research papers. Students study alone in this activity. E-mail provides a useful medium for collaborative writing activities between groups of students from various cultural and socio-economic backgrounds. Bulletin boards and Usenet newsgroups provide individuals the opportunity to read, reply and copy messages focusing on a specific area of interest. Web sites allow users to store documents and multimedia resources. Computer conferencing creates virtual classrooms that are communication and learning spaces located within a computer system. There are two types of computer conferencing. IRC (Internet Relay Chat), which allows users to see what is typed on other users' screens; and, video conferencing, which allows users to send and receive video images from people all over the world. One of the newest learning activities is virtual

reality, which gives users the impression of three-dimensional interaction. It is important that these instructional activities foster the use of the Internet for learning, by designing lesson plans around off-line resources.

Although there are many advantages to using the Internet in the classroom as a Mindtool, learners may become overloaded with information. It has been shown that users learn better when they apply certain strategies to learning tasks consciously so that the learning task directs their thinking and encourages them to monitor and evaluate their progress (Tsikalas, 1995). It is important for learners to develop learning strategies that allow them to know how to access information.

After teachers design their strategies for using the Internet as a Mindtool, there are numerous databases, which can be found on the Internet, to teach students how to access, analyze, and evaluate information. It allows users the opportunity to access information in different ways (Ryder & Hughes, 1997), so that learners can construct their own knowledge, and explore a subject while communication directly with experts or peers around the globe.

If we want to use the Internet efficiently as a Mindtool, all schools and faculties should have access, and individuals with few technology skills should be encouraged to improve those skills.

Today, we need classrooms with high levels of communication, interaction, and collaboration. The Internet can be a valuable tool in academic settings to enhance active, cooperative learning through interaction with people around the world (Smith, 1996). At this point, teachers have a very important role to play in the development of Internet applications for the classroom.

It is quite clear that the Internet will break the walls of the traditional classroom concept in the future. Moreover, instead of attending the conventional classroom, we will teach and learn with our own computers in our homes, and interact with people who live around the world. This is the unique value of the Internet as a Mindtool.

Multimedia

The use of multimedia in instruction is becoming increasingly popular. The concept of multimedia has been around long before there were computers. It was defined nearly two decades ago to describe instructional methods.

Today, multimedia is a buzzword whose specific meaning changes depending on the perspective of the users (Baumbach & Bird, 1996). While specific use varies in emphasis, the basic elements, such as the combination of text, sound, graphics, and video remain much the same. Kinraman (1995) emphasizes that multimedia technology can bring authentic settings into classrooms, but it is only recently that processing power, telecommunications speed, memory capacity, and CD-ROM based software applications have been integrated into desktop computers. This combination of interactive multimedia actively involves students in acquiring the knowledge, and allows them to regulate the way that information is being presented. It has great potential for learning due to the high degree of freedom.

Arnett (1995) stated that the application of multimedia technology in the classroom has the potential to help enhance and support the instruction of all students and provide tools for students to use in creating their own knowledge. It is easy to use multimedia-authoring programs, such as HyperStudio or Kid Pix, to allow students to create programs and combine multimedia elements for specific purposes.

Multimedia can be the focus for building instructional activities related to any trends and topics in curriculum and instruction, such as active learning, constructivism, learner-centered curriculum, cooperative learning, collaborative learning, etc. Thus, the dynamic use of instructional multimedia systems will help to promote enthusiasm and curiosity among learners. Moreover, it will have the potential to extend and transform the curriculum easily.

Conclusion

Critical thinking should be the most important practical goal and value of today's school and daily life. When thinking critically, we become active, productive, hopeful, and psychologically healthier people.

Due to the lack of critical thinking skills, students get confused inside and outside of their school lives. However, becoming a critical thinker is not easy. It takes a very long time, and a powerful, patient, and huge effort.

Today's teachers want the use of the new computer applications, such as Mindtools, because they supply new learning environments for students who are trying to become critical thinkers. Thus, teachers should determine how computer applications could be best used as Mindtools in the classroom.

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TEACHING ABOUT VS. LEARNING WITH TECHNOLOGY

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The way we teach, learn, transmit, and access information remains largely unchanged: the basic way that students learn has not changed for centuries, while around us communications technology is transforming the way we live and conduct business.

The following conditions exist today in American education:

> Faculty use the "talking head" approach to convey information; students are usually the receivers of information rather than active participants in learning.
>
> The textbook remains the basic unit of instruction; the memorization of its contents tends to be the primary measure of educational success.
>
> Teachers work largely in isolation; most other professionals collaborate, exchange information and ideas, and develop new skills on a continuing basis.
>
> While technology is often found in educational institutions, its instructional use is often limited to that of an expensive electronic workbook or page turner.

The Problem

Why do we still have a technology curriculum from K-12? Haven't we learned that mandating a technology curriculum isolates the technology from use in the basic curriculum areas of math, language arts, science, and social studies? The inference is there, but inferring the use of technology *within* the curriculum areas is not what works - we know that from the past 18 years or more of teaching about the technology - not*with* the technology. But, we are still writing and dictating the use of technology curriculum. We see it at the state and local levels. It isn't that there is not some attempt to integrate the use of technology into the learning environment - but - what do we read first when the "new" technology curriculum appears on our desks? Not how we can use it to help assist students learn about solving problems in everyday life, not how we can use the Internet to get in contact with our local government officials, not working with classes in various parts of the world in learning about different cultures. We read in the first few pages, "the student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections; start and exit programs as well as create, name, and save files;" "initiate disk;" "load paper properly;" "connect computer to CD-ROM." Somewhere towards the end of the document we may read some ideas on integrating these skills into the curriculum. Is it too late, have educators read from the beginning of the document and tried to implement the objectives written there before reading the back section where the ideas for integration *may* be written?

How did this problem originate? During the 1980's in the public schools, there was great emphasis placed upon teaching all students programming skills and teaching *about* the computer. Most educators today believe that the computer literacy movement was ill-advised, at least partly because the arguments for its justification were flawed. One of those arguments was that students needed to know how to program computers in order to get and keep a good job. This reasoning was illogical for a variety of reasons. For instance, there are only about 20,000 programming jobs in the United States and 40,000,000 students. In addition, not many successful programmers program in BASIC and Logo. Suppose 19 year-olds (6th graders from 1990's "literaracy classes") wanted to apply what they learned in those classes? Here's what they might be able to do: use an Apple IIe or IIgs or demonstrate a variety of DOS commands. Or perhaps name some of the parts of a computer.

The rationale for teaching students about technology is that such training provides preparation for a technological society, for a vocation, and for further academic study. Since computers play an enormous and rapidly expanding role in our society and in many of the jobs and professions our students will have in the future, doesn't it seem reasonable for them to know what a computer can do and how to use it? The gap between the time students received their training and when they could expect to use their skills almost guaranteed there would be no need for the skills they had acquired.

While it may be appropriate for electrical engineering and computer science majors to pursue the computer as an object of study, it may be highly inappropriate for non-majors to approach technology in this manner, if their goal

is to learn how to use technology in their discipline. One doesn't have to know RAM from ROM in order to use a computer effectively in most disciplines. In what appears to be a paradox, as computers and technology become more complex, users in fact may actually know*less*, rather than more about computers.

If you wanted to design an automobile from scratch, one of the individuals you would probably consult would be a mechanical engineer who had specialized in the design of automobiles. If you wanted to design a new computer from scratch, you would probably need the services of an electronic engineer and/or computer scientist. If you wanted to consult with someone about major repairs on your car, you would consult a mechanic; on your computer, you might consult a computer repair specialist. If you wanted to consult with someone about learning how to drive a car, you might consult a driver education specialist. If you wanted to get some ideas about how to use technology in your teaching, you might consult an instructional technology specialist. We must make this distinction among whom to turn to for guidance or run the risk of the misplaced expert syndrome. One consequence of this approach was the misplaced emphasis, especially in the public schools during the 1980's, placed on teaching technology as the object of instruction as contrasted with something to learn *with* rather than *about*.

Whenever a new technique or tool is introduced into an organization, the "old-wine-in-new-bottles" syndrome frequently occurs. The individuals in the organization have a tendency to bend the new tool to fit the old way of doing things rather than exploring or learning how the new tool might be used to perform additional tasks. While this approach may be an appropriate response under some conditions, it is an inappropriate response under most conditions.

One of the major questions posed by teachers and administrators is "How do we fit computers into the curriculum without lengthening the school day?" If technology or computer education is viewed as a new area of study that must be taught in addition to the regular curriculum, then it is difficult to find the time for a computer program without shortchanging another area of study. But if computer-related activities are designed to support the regular curriculum, they won't distract from it, but will enhance it.

Now What?

During the last ten years, the emphasis in computer education has gradually shifted from an emphasis on programming and the study of the computer itself to the use of applications or tool software. We have observed that not many teachers and students apply programming skills to solve real-world problems. However, applications software is easier to learn than programming and almost everyone who learns to use it sees an immediate application in her or his own work. Consequently, the computer becomes a practical tool that teachers and students can use in all areas of education.

A different approach to curriculum planning is to review each objective that is already in the school's curriculum and plan how technology can be used to enhance the attainment of those objectives. The rationale is that the technology is a teaching tool and that students should be taught with computers and other technologies when such strategies provide advantages over more conventional methods. One of those advantages is that students who use the technology in this way are using technologies in the same ways that people in the world of work are using them—persons in business, industry, manufacturing, education, and the military are using computers as a tool to make them more productive in their job or profession.

Technology as a tool works best when learning includes the process of finding data, information, or artifacts; making decisions based upon data; and communicating those findings to others. Technology as a tool works best when teaching includes the management of a learning environment that sets up environments in which students can work individually and in groups in data collection, decision-making, and communicating within the context of real-world tasks.

Examples of what Instructors/Teachers/Professors might try, include

- Keep records of grades, absences, advisees, former students in program, syllabi (including online versions), credentials (including on-line versions).
- Confer with colleagues and other experts worldwide
- Access information in on4ine libraries
- Manage instructional tasks
- Access, collect, and use data and instructional resources
- Prepare and use slide shows with classes
- Give electronic tests- give, score, and report electronically
- Make assignments available electronically
- Make provisions for students to hand in assignments electronically
- Consult expert consultant to local schools, as in Dr. Math, Dr. Art, Dr. History.
- Access up-to-date information in your specialized field
- Stay informed on a topic
- Participate in collaborative projects via the World Wide Web or e-mail

Examples of what students might participate in could include

- Acquire and become skilled in computer and telecommunication skills important for the world of work
- Learn how to locate, access, assemble, and evaluate a wide range of data and resources in one's area of study

- Communicate with other students and experts, worldwide, in one's field of study
- Access information and other resources in on-line libraries (full text in some cases)
- Access databases not otherwise available.
- Access to a wide range and assortment of resources not available at any one University.

A tool is not an end in itself, but a means to an end. Tools themselves do not teach; *neither should they be the object of instruction.* A tool is a means to an end, so it makes sense that technology as a tool should be integrated throughout the school's curriculum. In a technology-integrated curriculum, there is no need to add new technology-related objectives to a school's curriculum. Rather, schools examine the traditional curriculum and determine when it may be appropriate to develop computer-related learning activities for existing curricular objectives. An additional benefit of teaching with technology is that students learn to use tools that are commonplace in the work force. Students learn these skills in a relevant and useful context.

We are in the midst of the Information and Communications Age. Our total collected body of knowledge is expanding so rapidly that most of us have difficulty staying up-to-date, even in our own fields of specialization. In this era, knowledge of facts is not as important as the ability to find information when it is needed, to analyze and synthesize it, and to apply the conclusions to new situations. With the technology as a tool, students can focus more on thinking.

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WHERE DO YOU STAND TO GET A GOOD VIEW OF PEDAGOGY?

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As teacher educators in the UK with a commitment to the use of Information and Communication Technology (ICT) in teaching and learning, we live and work in 'interesting times', in which the cultural and political contexts of education and schooling raise challenges to many practices and beliefs. There is the potential for ICT to be the catalyst for significant change in pedagogy, yet the picture painted and the policies proposed are not yet reflected in the experience of many classroom teachers. What role can research play in providing a 'view' of pedagogy, both current and potential? How can knowledge and understanding of pedagogy with ICT be constructed by teachers, researchers and policy makers to promote effective teacher education in this field?

The purpose of this paper is to contribute to the discussion of 'ways of knowing' in the research process, for both teachers and researchers. The discussion will consider a question which has underpinned a research and development project focusing on teachers' pedagogy with ICT in the media arts. The initial inquiry focused particularly on the understanding of literacy within the contexts of both the media arts and the general use of ICT in education. The influences of culture, subject knowledge and pedagogy on the development of classroom practice were identified and presented within a framework which differentiated between 'mere' practice and 'good' practice.

After further research and reflection, however, it was acknowledged that this framework did not reflect the complexity of the interaction of these themes in developing pedagogy, nor enable the production of a satisfactory description of the experience of the teachers in trying to meet the many requirements placed upon them in the use of ICT in their work. The research paradigm needed to encompass both an interpretivist approach to the teachers' experience and action, and a critical theory approach to the constraints and contradictions of the requirements placed upon teachers by political and structural systems.

The Initial Research Inquiry

'What is the interaction between teachers' knowledge of pedagogy and their knowledge of ICT in teaching and learning?' This line of inquiry arose out of a desire to understand how the knowledge that underpins teachers' pedagogical practices interacts with the knowledge that they bring to their uses of ICT in learning environments. The nature and complexity of describing 'teacher knowledge' is recognized, particularly in a national context in which 'teacher knowledge' is increasingly defined and prescribed. The effective use of ICT in classrooms is, however, linked to teachers' theories, beliefs and understandings of the subject domain, as well as access to, and competence with, resources (Watson, 1993). It is this range of theories and beliefs that fuel action in the classroom and models of teacher education for continuing staff development should acknowledge and challenge these in supporting the development of pedagogy.

The development of ideas in the Brighton Media Arts Project

Phase One. The project set out to examine the notion of 'visual literacy' in Primary school children and the ways in which this could be developed in the digital arts. Its aims included the design and dissemination of curriculum materials which teachers could adopt and adapt to support their pedagogy.(Loveless, 1997). The children's use of image manipulation tools to develop their ideas in the digital medium reflected Street's 'ideological model' of literacy which is embedded in cultural practices, rather than an 'autonomous model' in which sets of skills or competencies are developed separately from the situations in which they are used. (Street, 1993).

Teachers responded to the work produced by the children in such project settings both positively and with anxiety. They celebrated the children's achievement, yet expressed concern about their own lack of ability to continue such work in the daily classroom context without the support of an 'artist in residence'. They described 'generation gaps' in their understanding of the ways in which children received and constructed meaning in contemporary media culture; they expressed lack of subject knowledge in the visual arts and the use of computers; and they perceived a lack of experience and understanding in their pedagogy which contrasted with the representation of knowledge of the practising artist working with the children.

The three themes of culture, subject knowledge and pedagogy were developed beyond the notion of 'visual literacy' and applied to the broader considerations of 'information literacy' in teaching and learning. The debate about what it means to be literate in the 'Information Age' is still developing. Street's models of literacy are useful in differentiating between a skills or competence model of information literacy (Neiderhauser, 1996) and critical model in which there is awareness of ICT in the wider cultural impact; the multiple representations of knowledge and the challenges to pedagogy (Loveless & Longman, 1997). These themes of culture, subject knowledge & pedagogy could provide a conceptual framework to pull together a model for 'good practice', in which teachers' theories and beliefs are examined in terms of their broad educational values and empirical evidence about the effectiveness of practice in children's learning. (Alexander, 1996)

Phase One reflected a view of research in which the factors which influenced pedagogy in a particular context could be observed, described and presented to teachers in order to support their practice. During the course of the project, it became clear that this approach to research and dissemination was unsatisfactory, both in providing accessible exemplars of practice for teachers and in describing their experience of 'coming to know' how to develop teaching and learning with ICT.

Phase Two. In designing the second phase, it was felt that the focus should shift to the teachers' experience of developing subject knowledge, ICT capability, classroom practice and critical awareness of the context of their work, supported by the practising artist and a researcher over an academic year. This shift in emphasis to the learning experiences of the teachers entailed a revisiting of the understanding of the different cultures impinging upon the teacher and the development of change in pedagogy. The research paradigm would also need to shift in order to provide means to describe the teachers' experiences as well as the wider contexts in which they were working.

Revisiting Culture in the classroom: Tectonic plates?

Teachers are influenced by many cultures which differ in their origin, demands and impact. The images of the purposes and progression of ICT in the wider society are reinforced by the priority given to ICT in education policy, both national and local. These contrast, however, with other education policies which describe the curriculum to be delivered, the nature of subject knowledge required of teachers and the teaching strategies prescribed for the raising of standards. The school and classroom may have limited ICT resources, inappropriate for the range of teaching strategies recommended, often contrasting unfavorably with those resources found in some of the pupils' homes. The potential for ICT to enhance, extend and change the role of the teacher can be perceived as an exciting opportunity or a confidence-crushing threat. Amongst these contrasting cultures within the national and local educational systems, there is the teacher's own sense of professional purpose, competence, values, relationships and emotions.

The demands for innovation and change can therefore be difficult, contradictory and confusing. The model of the development of pedagogy is not one of the teacher located at the center of a number of outside influences, calmly reflecting upon the way forward for effective action. It resembles more the meeting of tectonic plates, jarring and grinding against each other, creating mountain ranges and sliding faults.

Perceptions of the culture of ICT

The debates about the impact of ICT on our culture are well rehearsed. Our society recognizes the impact of ICT in the economic, educational, social and personal lives of its members and much use is made of terms such as 'The Information Society' and 'Virtual Culture'. The definition of these terms are not always clear and the images and expectations that they evoke are problematic, addressed in debates about new literacies, new relationships and new visions of the post-industrial society . Anxieties are expressed about the ways in which ICT can be used for controlling information, surveillance, marketing, invading privacy and models of intelligence. Virtual Culture is, however, also celebrated as providing opportunities for communication and collaboration between communities and previously marginalized groups; for blurring the boundaries of communities and individual identities, and providing new representations of knowledge. The information age is usually presented as good, desirable, inevitable and embodied in our children.

Policy for ICT in Education

Government policy for education in the UK embraces this positive and progressive view. The Stevenson Report, urged government to proclaim its priority to increase the use of ICT in schools (McKinsey, 1997). The White Paper, Excellence in Schools, highlighted the modernization of the comprehensive principle through a 'National Grid for Learning' (NGFL) (DfEE, 1997a) and the consultation for the Grid proposed on-line learning and teacher development materials for life long learning(DfEE, 1997b). All teachers will be expected to show evidence of specific standards in their ICT capability. These reports and developments for legislation reflect a political push for access to information and learning for all citizens. It seems to be assumed and uncontested that the first will lead to the second.

Policy for teaching and learning in schools

Against the backdrop of open access and flexible learning spaces is a contradictory rhetoric and policy about the nature of knowledge and pedagogy. The National Curriculum and Assessment framework in England and Wales presents a model of clear subject boundaries and content which can be assessed objectively in order to provide indicators of school effectiveness and performance. The nature of 'teacher knowledge' is addressed in current UK policy in the definitions of standards of subject knowledge and teaching strategies. There is a detailed model of a Teacher Training Curriculum and Standards, both in subjects - English, Mathematics, Science and Information Technology - and in general professional practice. This, however, has been recently questioned by a report which describes how effective teachers of numeracy were distinguished from other teachers, not by the level of previous subject qualifications, but by a particular set of beliefs and understandings, both about the pupils' learning and the subject itself. (Askew et al, 1997)

Teachers' experiences of their role and purpose

Teachers' perceptions and experience of their purpose and practice in the 'turbulent times' of educational reform need to be considered. There has been a number of key studies which focus on Primary teachers' personal and professional experience whilst coping with multiple innovations and change in their interpretation of autonomy and professionalism. Indeed, Hargreaves argues,

> while policy rhetoric stresses knowledge and technique as central to good teaching, I draw attention to the importance of purpose, passion and desire. Seeing teacher development in this light, I argue, highlights the central place of moral, political and emotional issues in the field. (Hargreaves, 1995, p9)

Revisiting Pedagogy: interaction and transformation

Pedagogy is often described as 'the science of the art of teaching', and addressed in teacher education as the development of specific teaching strategies and skills. It can, however, be described as a cultural practice (Giroux, 1997) and defined as the 'transformation of consciousness that takes place in the intersection of three agencies - the teacher, the learner and the knowledge they together produce' (Lusted, 1986, in Lather, 1990, p15). ICT could be considered to be a fourth agency, acting as a catalyst for the interaction between teacher, learner and knowledge (Loveless, 1995). Such a view does, however, highlight contradictions and tensions between the pedagogical practices required of teachers in current educational policy and the changes in practice made possible by the use of ICT.

Teaching in the Information Age

What's new? There are interesting and challenging claims made for the potential of ICT in teaching and learning. The purpose and role of the teacher can be clarified and refined in the context of using ICT (Scrimshaw, 1997a). Integrated Learning Systems, whilst reflecting a behaviorist model of learning, have been demonstrated to provide opportunities for teachers to develop their use of diagnostic tools and change their practice (Underwood et al, 1997). Scrimshaw notes that the National Grid for Learning has the potential to change the relationships between teachers and learners, parents and other teachers, as well as provide access to a wider range of human and material sources of information (1997b). The contexts in which teachers practice may also be changed by the use of ICT, both in terms of place and time. Teachers may become 'portfolio workers' in which they play a role many contexts - home schooling, electronic conferencing and managing flexible learning spaces.(Davis, 1997, Kenny, 1997, Meisalo et al, 1996).

What's not new? ICT can enhance existing pedagogy, from providing opportunities to develop composition in writing to developing graphing skills. The presence of the ICT resources and applications in themselves are not sufficient to promote or challenge understanding, and effective capability with ICT depends not on skills, but on the context in which the experience is embedded. Indeed, innovative teachers use ICT in innovative ways. (Watson, 1993)

Tensions. There is a long research tradition in the UK focusing on teaching skills and classroom management to promote higher order interactions between learners and teachers. The current focus is on interactive whole class teaching, which is more teacher-centered and directed. These developments, whilst providing the opportunity to look afresh at 'fitness for purpose', contrast with the picture of flexible learning associated with a constructivist approach to the use of ICT.

A Revised Framework for Research

The design of the first phase of the project had been an attempt to represent pedagogy in an 'autonomous' model of techniques and strategies which were not embedded in the cultural context in which values and tensions were made explicit. The position of the researchers looking for a 'good view' of pedagogy also had to change, from the observation and interpretation of an outsider, to a more constructivist stance of engagement with learners' experience and the provision of 'scaffolding' to support the development of action and meaning. In short, the research question changed from 'How does ICT support the development of visual literacy?' to 'What is the interaction between teachers' knowledge of pedagogy and their knowledge of ICT in teaching and learning?

Although the methodology used is similar - a qualitative, interpretive approach employing ethnographic techniques, the lens through which the data is seen and interpreted has changed. The cultural, political, emotional and moral experience of the teacher engaging with teaching and learning in the digital arts is admitted. The tensions and contradictions in the cultures that influence classroom practice are made explicit and the political structures recognised. The models of knowledge which underpin the current policies determining the form of teacher education do not take into account the contexts in which teachers are being asked to bring about these changes, nor the contradictions in those demands. The implications of the research for teacher training and continuing professional development are acknowledged.

The research paradigm of the project is shifting from realism to relativism. The image of the teacher constructing pedagogy from the tectonic grinding of different cultures developed from Rorty's discussion of the impact of acculturation, which can be transcended when 'our culture contains ..... splits which supply toeholds for new initiatives' (Rorty, 1991, p13) These tensions throw up the 'unfamiliar' ideas which can lead to the making of alternative practice. Smith also focuses on research as a practical and moral act -

> To ..... think, ... in terms of the images of a world made as opposed to found, has very serious implications for inquiry. If nothing else, such thinking places front and center our moral responsibility for the worlds we construct. Our judgements about inquiry .... must be framed by free and open dialogue and a sense of human solidarity (Smith, 1997, p27)

Riddle: Where do you stand to get a good view of pedagogy?

Answer: Find a toehold and change your spectacles.

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Engaging Educators in Asking the Right Questions about Technology Implementation

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In order to understand the purpose of this article, it is necessary to give the reader some back ground understanding of its roots. In the fall of 1997, I participated in a conference at Pennsylvania State University entitled, "Education and Technology: Asking the Right Questions." The conference was billed as an opportunity to honor the works of Jacques Ellul and Ivan Illich, and their works were discussed in light of the current environment of technology implementation in education.

There are themes in the work of Illich and Ellul that resonate with my world view of education. I wanted to learn more about the thinking of those who question where technology is leading us.

For nearly ten years I have investigated how technology is or is not infiltrating school settings and for what purpose. I have tried to figure out who is guiding the decision making on technology and what is their ultimate objective.

I have encountered a few crazed technocrats unwilling to acknowledge the limitations of technology, nor the complexity of its implementation into educational settings. My experience at the Penn State conference raised within the me an awareness of the futility of miscommunication between these two groups, or the worst possibility, the complete indifference of these groups toward their coinciding inquiries.

My intention here is to raise the possibility that there are mutual issues between the two extremes, which requires a conversation, due to their mutual interest in the improvement of education. For the purpose of opening the discussion, my comments will describe, and, in some sense, respond to the questions raised by Neil Postman during his presentation at the Penn State conference. I choose Professor Postman as the starting point because his discourse was balanced and reasonable. While some may consider him representative of some out of touch minority of anti-technical educators, his own presentation was clearly more open-minded than some of his critics. The questions he asked challenge each of us as educators and citizens. We are compelled to respond if we are to construct a discipline of education that resides in the real world and reacts to the issues of living human beings.

What is the problem to which this technology is a solution?

When first raised, the question appears uncommonly straightforward. Yet we all are aware of those instances where technology has actually complicated our lives. The point may be elaborated in this way: as a pragmatist, interested in solving problems, in what way can [insert any device] as a technology assist in the solution of [insert any problem]. With this understanding, the first step in technology implementation becomes identifying the problem.

There is the assumption that ail technology does is solve problems, or that all technologies solve

problems. Our first question requires us to rethink that assumption.

As educators, we must summon ourselves to answer this question regarding the implementation of technology into schools. What problem does technology solve for schools? There are some exciting answers. Technology affords students the opportunity for sophisticated simulation

lessons in areas impossible within traditional classrooms (O'Neil, 1995). Technology opens

students to huge quantities of knowledge through the Internet. Technology helps students learn the skills of technology, thus making them better prepared for a world permeated with technology. The technology of distance learning provides coursework to those who lack convenient access. The possibilities for creative educational software have barely been tapped (Dwyer, 1991).

Whose problem is it?

Assuming that there are problems related to communication, access to knowledge, and occupational preparation, who owns these issues? Who will benefit most from a solution to these problems? A cursory reply states that we

all benefit, students and society as a whole. But let us reflect more carefully on the benefactors of technology implementation. It is widely accepted that Bill Gates has benefited. And certainly other corporate technology giants have reaped the financial rewards of the soaring popularity of technology.

Hardly an educational official or school administrator does not stagger under the pressure to get more technology into their schools. School brochures are replete with students working on computers, or talking about their school's Internet connection. The assumption is that technology in the school computes to progress and a good education. Policymakers benefit by the positive political ambience of technology. Technology is a feature of American culture. Woe to the school person who questions the investment into technology. They are viewed as "resistant," "living in the past," and "unable to adapt"(Cummings, 1995).

But perhaps these resistors are concerned with this second question. Perhaps they want to know who will pay for the benefits that others are reaping. Perhaps they wonder what message the schools are sending about teaching and learning (Johnston, 1995). When graduate students are confronted with the convenient access offered by distance learning, they tend to be philosophical about the costs versus the benefits (Schuttloffel, 1997). They recognize their compromise; the personal interaction of a graduate seminar for the proximity of the convenient classroom.

Do students pay a price in the quality of education they receive with and through technology? Clearly the answer to that question is dependent upon the quality of technology used, the training and knowledge base of the teachers involved, and the balance of other opportunities for learning. (Van Dusen & Worthen, 1995). It is possible to build a case either for or against technology as a solution to learning problems . But each case is individual in context, tasks, teachers, and learners. Policymakers who decide about the implementation of technology are reminded to think of these when answering "whose problem is it?" which leads to the question "who will benefit and who will pay for using the technology (Schwab, 1973)?"

Suppose we solve this problem, what new problems will be created?

If problems exist with communication, access to knowledge, and occupational preparation and are solved through technology integration in schools, what new problems might be generated? This is not a nuisance question. Most administrators will attest to the fact that solving one problem, often creates new issues more problematic than the original. For this reason, administrators tend to tread carefully through the decision making process so as not to make their lives more complicated. The example of Internet access is interesting, due to the fact that most school districts are scrambling to get students on-line. Once the difficulty of getting the hardware and software in place is solved, several new problems emerge. Typically teachers are not prepared to integrate on-line materials into their coursework. With the exception of teachers with prior knowledge, they are often at a loss at how to best make use of this new resource. Teachers also have the problem of trying to prevent students from accessing inappropriate areas of cyberspace. And finally, there is the problem of the vastness of the Internet, itself. Access is not the final problem with the Internet. Access just opens the door to a multitude of decisions that must be made concerning paths and routes. Time can be easily spent on the Internet with little to show for the effort.

While much focus is placed on how crucial technology is to prepare students as the future work force, often less effort has been given to prepare the current group of teachers. Teachers today see their profession changing in ways they did not imagine or anticipate. Most teachers lack the educational preparation to analyze software, investigate the Internet, and design new technology integrated lesson plans. These teachers are not oppositional to the technology, they just do not have the technical skills. Recognizing the situation with in-service teachers, it is enormously crucial to provide technology learning experiences to our preservice teachers (Zachariades & Roberts, 1995). Too often course requirements do not adequately prepare students to actually integrate technology into their teaching in the content areas. As we prepare teachers for the school of the twenty-first century it is imperative that veteran teachers are not left behind as the toll paid for technology progress.

Which people and what institutions might be most harmed by this technology?

This question does not disparage the positive contributions of technology to modern life. There is little chance that many of us would leave our modern conveniences for "the good old days." Everything from the telephone to the dishwasher has become a staple of our modern life style.

These items support the lives we are able to live. The telephone serves as good examples of the intent of this question. The telephone has effectively closed the distance gap. To visit with friends and family around the world via the telephone is commonplace. As a child of the 50's, the long distance call had an ominous quality, usually relating the passing of a distant relative. Today, my children make and take international calls casually. Generations of family members have the ability to stay close in spite of the mobility of modern life. The telephone has generated the global economy.

Has anything been lost? In one sense the art of letter writing is on the verge of becoming a piece of antiquity. The telephone has replaced letters as the prominent form of communication between friends, family members, and business associates. The ability to construct prose for a letter is fading. I suspect there is little mail that will make a future text of love letters. The telephone often removes the desire or obligation to visit distant relatives and friends for a thorough conversation. But at another level the telephone has become a dominating feature of our daily lives. We wait for phone calls. We jump up to answer the telephone. We make present persons wait while we talk on the phone to others. And if that bit of discourteous was not enough, call waiting has provided the means to disrespect two individuals simultaneously.

Possibly the institution most changed by the advent of technology is the American family (Elkind, 1995). The television changed family life forever. One can argue that the content of some television is worthwhile, but it is more difficult to argue in favor of the vast amounts of time American children spend facing the screen. It seems the only cure for the situation was the advent of another screen, the computer monitor. The issue is both one of the quality of the activity on the screen, and the activity away from the screen that the viewer is missing.

The institution confronted by this is the educational system. Is it possible that technology implementation could create problems for the survival of the American school? Or as some have stated, is technology the means to ensure the survival of the American public school (Papert, 1980; Nickerson, 1988)? The disbursement of public funds for the purpose of integrating technology increasingly haunts American schools. This situation is not unique only to public education, as parochial and private schools feel the social pressures. However, the response of the public schools is pivotal, particularly in those urban districts where resources are scarce and expectations for results are burgeoning. How does an administrator explain to teachers, parents, and students that the Internet connection has been installed, but there will be no textbooks for math or science classes? There are no new building plans or teacher raises in the offering, but new computers are purchased.

What changes in language are gained and lost from new technologies?

The implication that technology is natural and has not changed us culturally is naive. An incident in an elementary school illustrates the change clearly. In a kindergarten class, the teacher set up a record player with a 78 RPM record. As students entered the room after recess there was a great deal of discussion when finally a vocal student asked the teacher, "What is that thing in the front of the room?" The teacher and I looked at each other and smirked a little. We both later commented that we doubted there would have been that reaction to a CD-player. Technology has infiltrated our lives to such a degree it is difficult to know where its impact starts and stops. Kindergarten classes are great for cultural excursions because these children have only known a technological world. Even inner-city children recognize cell phones and CD-players.

The technological impact does not end with our nation, the creation of a global culture is one result. A colleague recently returned from a trip to China where the effect of plunging a country into the technological age is very apparent. She was taken to visit a construction site where she was proudly shown the foundation of a new computer center. But she was struck by the construction workforce. People were carrying cement in jugs suspended from a rod balanced on their shoulders. The crash between technology and underdeveloped countries is loud.

At the same time we cannot but recall the impact globalization had on bringing down the Berlin Wall. It was impossible to maintain isolation with a brick wall or even an Iron Curtain. Technology is capable of transgressing into these barriers. Witness how Saddam Hussein uses technology to bargain his political platform to his people and the rest of the world. Or, think how casually we use the term "spin doctor." Would that concept even be possible without the new technology?

What sort of people or institutions acquire special economic or political power due to the new technology?

Look again at who gains from the promotion of technology. The stock market is filled with technology companies. Clearly, there is money to be made with technology in schools. Education is a huge marketplace. Publishers know the value of the education market. It does not stop at the schoolhouse. Parents are eager to give their children every advantage and technology items top the list. If Americans are clamoring for technology in the schools, where is the political power to make this transformation happen? It is interesting to note that when President Clinton had his most recent education conference corporate leaders showcased the event. The connection between big business and educational technology is direct. Business has built a case for technology in the schools by declaring that students who lack technology skills will be unemployable (Baines, 1997). The fear of the United States losing its position as an economic super-power drives corporate America to infuse its agenda into education. This is not a new phenomena. Most twentieth century education is predicated on its relationship to the world of work. The utilitarian nature of American education ties nicely to American business.

From this environment, technologies emerge as the power-holder-makers. The premise is, that if students lack

the knowledge to use technology, their future contribution to society and their personal fulfillment is in jeopardy. This assumption places large numbers of American students into a potential state of marginalization. What sort of people or institutions acquire special economic or political power in this situation? First, those that currently have power stand to gain the most. Their position and holdings set the stage for further advancements. Those that have the necessary experience and insight to acquire power benefit with the next increment of influence. Finally, those that currently rely on the benevolence of others in order to experience power-holding are least likely to be promoted by their experiences into powerful influence.

Asking the Right Questions within Teacher Education

These questions were directed to education in its broadest sense, but their potency as a standard for teacher educators is tangible. Teacher education is a profession steeped in the pragmatic and practical world of daily life in schools (Rosenholtz, 1989). Teachers espouse their philosophical roots but often do not recognize the connection between philosophy and the decision making that comprises teaching. Teaching is mindful decision making (Zumwalt, 1989). Teaching requires an understanding of how we teach and learn with substantive pedagogy and with intense content knowledge. Teaching also sends a message about what is valued within the classroom, school, and society. Students and teachers interpret the message of the school and allow that message to shape learning. Finally, teachers must reflect on the why motivating their decision making for teaching is mindful. Mindful means that we have participated in a metacognitive process that encourages understanding and in a critical sense questions the purpose and consequences of our decision (Flavell, 1976).

Teachers will not have the qualities and skills necessary to make decisions mindfully unless teacher education programs shape their learning experiences to promote reflective practice. Preservice teachers have the opportunity today to be exposed to a knowledge base that did not exist a few years ago. Our understanding of metacognition alone challenges us to examine how we teach teachers to teach. Schools that operate with site-based management, parent councils, and business partnerships mandate teachers be prepared to present their professional knowledge to these audiences. The risk is to be left behind as others define education for us.

Technology offers new approaches and strategies to perform the *how* of teaching (Robinson, 1995). Our schools and our society clearly send the message that technology is valuable. Our culture espouses that the knowledge of technology is valuable. The modern world defines a valuable person and a valuable society as having the artifacts of sophisticated technology. We are enchanted by signs of ancient civilizations with technology that seem to demonstrate rare capabilities. Technology's message is that we cannot live without it, and perhaps we cannot live in the way that we have grown accustomed. Just as we are realizing the limits of the technology that our natural environment can sustain, so-called underdeveloped third world countries crave the lifestyle we wish to inhibit. Our students must be prepared to think mindfully about the decisions made within their classrooms, schools, district, society and world about technology. Teachers must lead students to consider those who do not benefit from the encroachment of technology into their fragile culture. Yet technology continues to challenge us with the possibility of bringing all people forward through its potential.

This does not preview a future of negative scenarios wrought upon us by technology, as some might claim. In fact, I am optimistic that we are still the master of technology as long as there are educators who ask the right questions. I am hopeful that teacher educators will recognize the priority of preparing mindful teachers who are capable of asking the right questions and following up with reflective practice. And I am confident that teacher educators will seize the moment to lead in demanding the right answers for the welfare of our students, our nation, and our world.

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ogy a natural component of preservice language arts courses substance is provided that is frequently absent in survey courses. Therefore, we begin our course with an in-depth theoretical rationale for the instructional approaches that will be presented. This foundation is then used to build bridges between traditional practices and technology. As an example of how this approach works in practice we introduce CD-ROM talking books to preservice teachers during the unit on children's literature. In another instance, the pros and cons of skill-based phonics programs, both in print form and on the computer, are presented during study of phonemic awareness. The instruction described in this article has demonstrated how one such language arts topic, young children's composing, can be approached to include the research background on the topic, knowledge of symbol-weaving using traditional tools, and, finally, how multimedia composing programs can enhance symbol-weaving processes.

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NURTURING EMERGENT LITERACY THROUGH TECHNOLOGY

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Becoming literate is a process of becoming aware, not only of oneself as a reader, but of strategies that help to solve problems that arise during reading (Vacca, Vacca, & Gove, 1995). Young children who are exposed to environments rich in print and language have opportunities to utilize multiple sign systems to mediate the activity by defining and shaping it. In effect, the use of sign systems becomes a means of negotiating their interaction.

Emergent Literacy, Semiotics and Critical Thinking

Through their work on semiotics (how signs work), Siegel and Carey (1989) propose the notion that thinking critically is a matter of reading signs. Harste (1989) notes that our understanding of critical thinking is a construction of signs, which enables us to think critically about critical thinking itself . The role of language in critical thinking is that language allows individuals to name their world, it provides the signs that make thinking public, and it allows language users to distance themselves from their knowing. Ideas can be set aside, looked at, thought about, and evaluated.

Gestures, pictures, monuments, visual images, finger movements—anything deliberately and artificially employed as a sign is, logically, language (Dewey, 1933). Siegel et al. (1989) refer back to Dewey's description of reflection as involving the movement forward to possible conclusions as well as the more traditional movement back to uncover the grounds or bases for some form of knowledge. The signifying function makes it possible for the simultaneous movement back and forth. Understanding the way in which one thing signifies or stands for another is central to understanding reflection and, consequently, critical thinking (Siegel et al., 1989).

Siegel et al. (1989) discuss the implications and importance of semiosis for critical thinking:

1) Semiosis shows that our knowledge of the world is mediated. We don't just encounter shapes and sounds; we encounter a world made meaningful through the mediation of interpretants—networks of signs.
2) The triadic nature of the sign suggests that meaning is not reducible to the sum of its parts. Semiosis requires the participation of all three components of the sign where each component serves as a connecting link to the other two.
3) The fact that signs generate interpretants which point to something other than what the sign represents suggests that sense making involves the creation of new ideas. This implies that we can not evaluate knowledge without simultaneously generating knowledge.
4) What's intriguing about semiosis is that it both conceals and reveals this swirl of interpretants to us. They argue that we do not usually think about how we make sense of our world; we take sense-making for granted, at least until we encounter something that doesn't make sense, thus offering the possibility of reflection.

It is my belief that the work of Siegel et al. highlights the importance and significance of sign systems in literacy development of young children. They argue that all thinking is critical (Harste, 1989). Critical thinking is what people do in an attempt to understand and act on what they see, read, hear, feel, etc. (Harste, 1989). In effect, young children illustrate what it is to think critically as they use the resources provided by multiple sign systems (e.g. oral, written, and graphic) to negotiate, interact, act, manipulate, and respond to the world around them.

Expanding Our Definition of Literacy

Reinking (1994) states that it is becoming increasingly apparent that educators and educational policy makers must now expand their definition of literacy to include the reading and writing not only of printed texts but of electronic texts. These electronic texts have been available for many years, and they range from simple copies of traditional books to those that are increasingly more complex. For example, the computer can read aloud the story in a variety of voices, change the appearance of text, use background music and sound effects, identify problem words, pronounce words, or even explain the meaning of words (Willis, Stephens, & Matthew, 1996). As a result, these electronic texts can serve to reinforce children's knowledge about written language and how print differs

from pictures, the meaning in print, letter-sound relationships, conventions of print, and the practical uses of literacy.

Reinking (1994) notes that the pedagogic potential of electronic texts is that they provide support that beginning readers need in order to focus on meaning and at the same time help them learn to identify words. Children and their teachers also see that electronic texts can facilitate higher levels of independent reading and understanding. He goes on to conclude that as educators look for new ways to help children become more literate, and as electronic technology becomes more advanced and more available, our ideas about what it means to be literate will almost inevitably expand.

Play at Reading Books

May (1998) states that what children really need is a learning environment that allows for unsteadiness, one that never shoves but only gently nudges them toward greater awareness or self-discovery of the utility and beauty of thinking, writing, and reading. This notion is based on the Vygotskian concept that learning requires apprenticeship experiences (Vygotsky, 1978). A second implication of Vygotsky's views on apprenticeship learning is that the child-apprentice should gradually take over more responsibility for his own learning (May, 1998). If the novice takes over increased responsibility for the task at hand, then we can infer, retrospectively, that our help was well timed and well tuned, and that the novice was functioning in his or her zone of proximal development, doing first with help what he or she could very soon do alone (Cazden, 1988).

This support provided by electronic texts becomes one way that the child-apprentice can reinforce print concepts acquired during other literacy events, and interacting with this form of text enables children to "play at reading books". Vygotsky considered play to be the principal activity for the interiorization and appropriation of reality during the first years (Blanck, 1990). Play enables children to stretch their imaginations as they explore the role of reader through literacy interactions supported by electronic texts. As Vygotsky suggests, play, itself, mediates the learning of children (Goodman & Goodman, 1990).

Therefore, one of the most valuable supports offered by the electronic texts is that children are able to participate in independent engagements with literacy. They become more familiar with the stories, which encourages them to eventually attempt to read the texts on their own. In so doing, the emphasis seems to be on the creation of worlds of discourse: Each world has its own rules and possibilities for action and interaction (Scollon & Scollon, 1984). Scollon et al. (1984) call these worlds of discourse microworlds.

Technology as Literacy Support System

The use of technology as part of the literacy support system can be illustrated through a four-year old girl's (Reghan) interactions with electronic texts. One of the books chosen often as a read aloud favorite was the Dr. Seuss book *Green Eggs and Ham* (1960). The repetition and predictability represented by the text enabled Reghan to read along throughout portions of the text. In the Living Books electronic text format, children are offered two options: 1) Read to Me, or 2) Let Me Play. Reghan was shown how to load the CD-ROM into the computer, wait for the program to appear on the computer screen, select [Run], and then choose between option one or two. After trying both options, she began to invariably select Option Two where she is able to interact with the computer, as opposed to Option One where the story is read from start to finish for her.

In the second option, she determines whether she will go forward or backward a page, click on objects on the page, click on the text to have it reread to her, click on words of the text to have a single word read to her, or click on a picture in the text to have the word it represents read to her. Her choice for an option that allows more control on her part represents her desire to be involved in the discourse that occurs within this interaction. In other words, she has created her own microworld of discourse where the rules and possibilities for action and interaction allow her to have more control and independence. It also gives her more of a role in the interaction as she "plays" at reading the book.

When she initially became engaged in this microworld, she would randomly click around on the screen to have objects (e.g. click on the hat to make a bird fly out) become animated. After a text page had been read to her through the multimedia system, she began to be interested in her ability to make the text talk to her in individual words (e.g. click on a single word in the text) or having the text reread to her completely (e.g. click on the green egg at the very beginning of the text). After she had chosen the second option on numerous occasions, Reghan was asked why she chose it instead of the first option. After much prodding, she finally responded in an exasperated voice, "I like this one that plays. The other one just reads the story." This response and her actions with the electronic text indicate that she wanted to have more control and choice during these sessions.

In this same session, she was asked what the pictures located within the text meant. She initially responded, "I have no idea—Oh, I know." She then moved back to the beginning of the text and began clicking on each word while reading along with it, "I—would—not—like—them—here—or—there—I—would—not—like—them—anywhere—I—do—not—like—green—eggs—and—ham—I do—not—like—them—Sam-I-am." As she clicked on a picture that represented the text, she would glance over to be sure that the observer had seen the word briefly appear when she clicked on the picture. As demonstrated by this exchange, her knowledge of the text was coupled with her awareness of each word that was represented on the page.

After she had finished listening to the text again, she was asked if she could find the word "green" on the page. She first clicked on ham, and when this proved to be incorrect, she tried eggs. She studied the screen for several seconds, then clicked on the green egg to have the text reread for her. In this example, her actions indicate an emerging awareness of rereading as a strategy for locating information in the text, which was made possible by her interactions with the electronic text.

Reghan also benefited from strategies provided by the observer. At one point, Reghan was told by the observer she could identify "green" because green begins with the "g" sound. Though this was a little beyond her independent ability to identify the word, she was only able to use the word "green" with the aid of the observer. The use of that strategy to locate the word in text is not one that she initiated on her own, but it was the presence of the "other," as mentioned when discussing Vygotsky's ZPD, that served to nudge her use of graphophonemic knowledge to verify a word in the text.

Several pages later, when Reghan was asked to find the word "fox," she used a similar strategy to the one described above to locate the word within the text shown on the screen. In these examples, she demonstrated her developing print concepts including: (a) how print is read from left to right, (b) that lines of text move from top to bottom, (c) individual word representation, and (d) how individual words could be used to access information.

In another example that illustrates the powerful support system offered by the electronic text format became evident when Reghan had finished listening to one of the pages in the book. She moved to the beginning of the text and clicked on the individual words as she listened maintaining a pace that was only a bit slower than the computer's reading of the text. During this process, she inadvertently left out the word "eggs" so that the computer read, "green and ham." She looked at the screen and paused for a second, and then she went back to the beginning and repeated the process so that "eggs" would be included. When asked why she had done it twice, she responded, "I accidentally (clicked on the wrong key)...I didn't punch that (word)" while pointing to the word "eggs." By listening to the text, Reghan recognized that a word had been left out, and she used the strategy of rereading with computer assistance to rectify the mistake. Reghan also demonstrates metacognitive awareness (Lundsteen, 1990) when she points out her failure to click on eggs.

Technology as a Means of Empowering Literacy

As illustrated by these examples, Reghan has used multiple literacies and sign systems to mediate her own emerging literacy development. The role of the computer through use of the electronic text format served as a means of empowerment for her. Empowerment grows out of the fact that the individual learner can experience some direct, visible outcome of a physical action (e.g., lively pictures and audio sequences resulting from the click of the mouse) (Meskill & Swan, 1995). The microworld (Scollon et al., 1984) in which Reghan chose to participate was one where she had more control of these possible interactions.

It was during this time, that Reghan's growing metalinguistic sophistication became evident as she utilized her growing knowledge of print concepts to read the text.

Reghan also utilized metacognitive strategies as a means of monitoring her reading of the electronic text which was illustrated by her use of rereading to monitor comprehension of the text. In the last example, not only did she recognize that she had left out a word, but she took steps to correct the error. Teale and Sulzby (1988) discuss that a characteristic of young literacy learners is that they learn through active engagement, constructing their understanding of how written language works (Teale et al., 1988). Through these examples, Reghan illustrates her own active engagement with the text, and her growing understanding of how written language works. Technology as a literacy in its own right served as a support in her developing understandings of written and oral language. Bertram (1990) states that we cannot begin to understand the role of technology in literacy if we set it apart as "only a tool;" instead the picture is more one of multiple literacies, each employing a wide range of technologies that overlap with those of other literacies.

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TEACHING THE ESL CHILDREN WITH THE HYPERMEDIA PROGRAM

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With a rapid advance in development and application of technology in education, computer instruction in education, such as computer-assisted instruction (CAI) and especially hypermedia-aided instruction (HAI), has an increasing important role in English as a second language (ESL) teaching, learning and acquisition. Though there are controversial results of the use of CAI for ESL instruction, the positive effects of CAI can not be ignored. Technology is important in our modern life and so schools have tried to embed multimedia, the internet and even hypermedia in their language curricula in order to teach English to ESL learners.

Background

This is a follow-up study to the investigations aiming to discover the effect of the program on actual ESL instruction and learning. A hypermedia program was developed from a program that was originally in print form. The project was in use at the Children as Authors Project at Central Elementary School, Morgantown, West Virginia, in which ESL students from nine different countries attend during 1996. Before putting the paper-form children's story into a hypermedia program by an instructional technology graduate student, the Literacy Group members, consisting of five university faculty and public school teachers, evaluated educational software and determined preferences of their students. When the program was complete, they brought the students in to make a final evaluation. Though simple, it was an English-Chinese hypermedia program which integrated text, colorful graphics, sound and animation, with the ease of navigation and interaction of buttons on the screen. Every story page contained at least three animations associated with the three vocabulary words or phrases from the text at the bottom of the screen. English words and narration would come before the corresponding Chinese characters and narration. After each click on a hotspot a colorful graphic appeared that described the words. Users could listen to the whole texts or vocabulary as many time as needed, navigate to the identical Chinese pages aimed at aiding Chinese ESL learners, as well as creating their own stories to be stored onto a floppy disk.

Literature Review

The widespread use of computer and other technology in education has become prominent. The advantages of computer-assisted instruction have appeared in various types of research literature. Motivation is an important effect of CAI in ESL instruction and learning. Greatly motivated and deeply engaged, the children actively interacted with computers (Cohen, 1993), willingly repeated their computerized assignment (Bowman & Plaisir, 1996), thereby learning the content more thoroughly. Another important feature of CAI is individualized instruction or privacy. ESL learners learned independently. With these programs, students didn't worry how many errors s/he made or what difficult level s/he was (Lalas & Wilson, 1993; Radencich, 1994). The computer was also patient, able to conduct simulations, to provide instructions on demand, provide immediate and meaningful feedback, and record keeping and interaction (Wang & Chan, 1995). CAI also created a positive learning situation fostering good personalities such as self-learning and self-organization, self-esteem, concentration, memory, methods of work and the pleasure of working in addition to providing a large amount of information and opportunities of self-correction and plenty of information (Cohen, 1993). If CAI were used, it would encourage excellent attendance (Bowman & Plaisir, 1996) since while using the program they would feel like authentic writers (Wrigley & Guth, 1992). Cooperation also an important feature of CAI. Through sharing their skills and knowledge, the learners learn the new materials and solve the problems together (Wirgley & Guth, 1992).

Research has describes enriched verbal exchanges through comments and discussions supported by text, graphics, and voice. The students improved their elaboration of the pictures exposed to them, enlarged their vocabulary, and bettered their sentences with the help of their teacher. They solved normal problem of writing which they could not tackle with a pen or pencil (Cohen, 1993). Besides providing interactive opportunities of English language learning and acquisition, new technology guided the learners to inquire about information, express their emotions, and utilize their first language (Lalas & Wilson, 1993).

Many teachers and researchers have blamed poor quality of software on the lack of integration of existing software into curriculum and the inability to achieve ideal

teaching and learning outcomes. Of the software evaluated for the ESL population, 58.5% was drill and practice, 24.8% tutorial, 5.5% simulation, 12% problem solving, and 10.8% game (Mansoor, 1993). In the area of ESL grammar software, drill and practice occupied even a larger proportion. Current CALL software is very limited and disappointing because most products were not created by experts in education (Baker, 1995; Hunter, 1996).

Besides the problems of technology and software development, inappropriate use of technology is another recognized problem. Many educators used technology as a "baby-sitter" under the disguise of "learner-centered", entertainment and drill and practice (Green, 1995). Not surprisingly, many educators considered that some application software (e.g., word processing, database, and spreadsheet) could generate better results than the available educational software for literacy teaching (Wrigley & Guth, 1992). Even with great educational software, instructors and researchers should have the ability to evaluate and select the appropriate courseware according to the learners' needs, characteristics, goals and interests, and efficiently use the equipment. Without considering the above factors, technology could be used very poorly, especially as a single method to teach literacy (Mansoor, 1993; Wrigley & Guth, 1992).

Hypermedia, while possessing all the advantages of general computer-assisted instruction discussed above, has its own unique strengths consisted; namely: (1) Hypermedia uses the power of computer and multimedia to present huge amounts of information: (2) Hypermedia displays information in chunks which are linked to one or various nodes; (3) Hypermedia provides contents in a non-sequential way at a high level of learner-control so that users can access the information using different paths according to their needs, interests and/or choices (Liu, 1994; Meadow, 1996).

The role of native language is not always considered to be positive in second language learning because of first language interference, although there is a long history of the use of native language used in the grammar-translation method. At present, many language teachers and linguists have been reconsidering the role of the native language in second language and language instruction and learning.

Purpose of Presentation

The purposes of this presentation are three-fold: (1) What is the effect of the hypermedia program "There Was A Rabbit Named Bunny" on teaching the young ESL learners English language: (2) What do the ESL children think about the hypermedia program, the role of their native language, and their attitudes toward computer use in education? (3) What should preservice language teachers be concerned about in terms of the application of hypermedia-based instruction to ESL learners?

Design of Study

Participants

The sample was comprised of eight public elementary ESL students with limited English proficiency (LEP): two girls and six boys including one Japanese first grader and one Korean kindergartner. They were selected from among the international children in the small elementary school in which the "Students as Authors" Project was located.

Materials

The story that arose from the "Students as Authors" project in both the hypermedia program and paper form was used to teach the ESL children. The hypermedia program with its alias on the desktop was installed on a Macintosh computer, whereas the colorful book-form story had three versions: English, Chinese and Picture. Blank paper, pens, pencils and other stationery were also available to the learners during the instruction and learning.

Procedure

The ESL learner was taken away from his or her classroom and brought into the reading teacher's office, a familiar place to all the students, with the instructional equipment and materials available there. All the ESL children experienced four 20-minute sessions: book session, hypermedia session, writing session, and vocabulary testing session. Following the session was a 10-minute interview, but it could be shorter, depending on those young students who had or little response to some questions.

During individualized instruction, the whole story was separated into two parts—three pages a session. Randomly divided, the children might learn any half section of the story through the hypermedia program or the book so that this presenter could examine the different learning results due to different instructional environments instead of different teaching strategies or content. The students were required to examine a picture of the "Bunny" story either on the screen or in the book, and then told their stories. When being taught through the hypermedia program, they could view the animation along with the sound or music, listen to the narration of the text, and/or click the spots where the mouse cursor changed to learn the vocabulary words. When they learned the other section in book version, the ESL learners could neither see the animation nor hear the sound or narration; instead, I read the text to them and taught the vocabulary words identical to those embedded in the program. To avoid the confusing results due to the different teaching approaches rather than the two instructional environments, I implemented context-based approach to both teaching periods without letting the computer or the book be the sole controller.

In regard to writing or recreating their stories, the ESL students were required to write a short and creative story based on what they had learned. They had to write about a

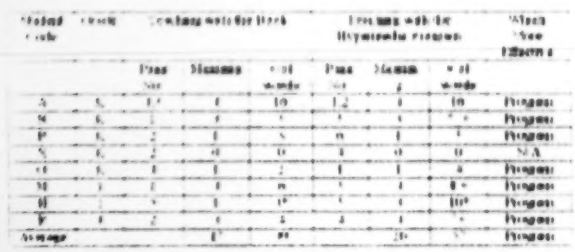
story page randomly chosen from a section so that they had two pages in total to write if they could, because there were two sessions: hypermedia and book.

In the testing vocabulary recognition session, all the ESL learners came to the auditorium and sat far away from each other. After the instructor repeated the story twice per page and then the words in a random order, the students had to recognize the vocabulary words among a group of unordered words. There were no pictures or other cues involved as visual aids during the test.

Data collection and analysis

The methodology of this study was qualitative including observation and interview. Observation was conducted during instruction and learning, so that whenever possible the key words were recorded and later expanded. Interviews with each ESL learner were taped after the instruction and testing. Chinese language was allowed for the students who encountered difficulty expressing their opinions, and the interview questions were repeated a few times or broken into simple sentences until they understood them. The interview data on the tapes was transcribed later, coded, sorted, categorized and then analyzed later with the observation data according to the themes. The data from the story creation that was taken down in my notebook while the students were writing was analyzed according to the number of words in each sentence, the completeness and meaningfulness of a sentence. Analyzing vocabulary recognition data was through comparison through tabulation.

Table 1.
Teaching with the Book and Teaching with the Hypermedia Program



Note. *(1) "+" indicates that the words had not been counted as the ESL learner looked at the dimmed title bar of the hypermedia program. (2) "" refers to the case that the learner first tried to write the story on a piece of paper with a pencil, and later tried to write a story about the same picture on the hypermedia program.*

Findings

Story Writing

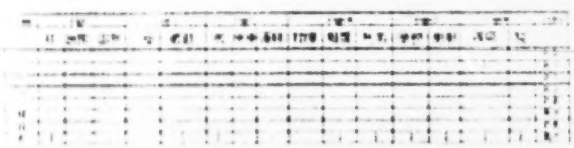
The following table records the ESL learners' story writing according to a specific page of the entire story. Although all of the "created" stories based on the pictures were very close to the repetition of the original story, there were differences in degree of meaningfulness, quality, and length in their writing samples. The ESL learners wrote better and more complete sentences relevant to the sections of hypermedia instruction than the group of students underwent instruction with book materials.

The results from Table 2 showed that the ESL learners achieved 28 correct out of 66 possible counts in the book section, while 33 correct out of 62 possible counts in the hypermedia section. Examined individually, majority of the learners performed better in the section that they were taught through the hypermedia program than the one that they were instructed in the book version.

Table 2.
Vocabulary Recognition According to the Story Page Narrated by the Instructor (English Version)

Note. *(1) 28 out of 66 subtotal counts in the book sections were correct, but 33 out of 62 subtotal counts in the HAI sections were correct. (2) P referred to program and B referred to book.*

Table 3.
Vocabulary Recognition According to the Story Page Narrated by the Instructor (Chinese Version)



Even though all of the ESL learners involved in this study were from Asian countries and their native languages derived from Chinese characters, they did not incidentally learn any Chinese words (See Table 3). The exception is student R, a newcomer from China who had been learning Chinese for three years so that he had known all of the Chinese in this story; while student X whose mother taught her Chinese at home recognized about one hundred Chinese characters including some of those Chinese characters in the story but she figured out only one correct Chinese vocabulary in the context.

Data from Interview

The following data was derived from the taped interview conducted after the instruction and the testing.

1. Do you have a computer at home?

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Yes: 6 No: 2

2. What do you do with your computer at home?
   Games: 8 Learning: 3
3. Do you do anything like typing or writing on the computer at home?
   Yes: 1 Sometimes: 5 N/A: 2
4. How long or how often do you spend typing and writing on your computer?
   2 times a day: 1 I don't know: 6 N/A: 2
5. When you write something, do you like to write on a computer or with a pen and paper?
   Computer: 8 Pen: 0
6. Do you like to write on a computer? Why?
   Yes: 7 Fast: 1 Convenient: 1
7. Do you use computer at school too?
   Yes: 8 No: 0
8. What do you do on the computer at your school?
   Typing: 3 See words: 2 Listening: 1
   Play Games: 2
9. Do you like to write something on a computer or with a pen?
   Computer: 7 Pen: 1
10. If you write your story for the first time, which will you like to use, computer or pencil?
    Computer: 8 Pencil: 0
11. If you are going to write something, do you like to write it yourself or with someone else?
    Self: 1 Someone: 7
12. Which form of Bunny story do you like, the computer program or paper book?
    Computer Program: 8
    Book Story: 0
13. Why do you like or dislike the story on the computer program?
    Like: 8
    Read by itself: 4
    Chinese and English: 1
    Sound: 3
    Don't need to flip the pages: 1
    Colors: 3
    Typing: 2
    Moving: 5
    Button: 1
14. Do you like computer or not?
    Yes: 8 No: 0
15. In future, will you like to use computer more or less?
    More: 8 Less: 0

Discussion

The findings from the selected ESL students' interaction and learning with the program show that the outcomes of the hypermedia instruction sections are more promising than the book instruction sections, with more complete sentences and words in their writings. In terms of "incidental" vocabulary recognition, the ESL learners obtained a 53% correct rate in the hypermedia sections but only a 42% correct rate in the book sections. This study supports the previous findings that CAI or HAI is more effective than conventional instruction. All ESL learners had their turns to learn a half portion of the story in the environment of conventional instruction and the other in hypermedia-assisted instruction. The teaching strategies and contents were identical; therefore, the difference resulted from the teaching and learning environments.

All the ESL learners' attitudes toward the hypermedia program are very positive. They willingly repeated working with the text and vocabulary words. Student X refused to learn the story after flipping through the book and stayed on the hypermedia program for 15 minutes and repeated some words or sentences. Another interesting finding occurred when, student H, who was told to write his story based on the picture of Page 5, produced only a three-word sentence with a pen and paper, but a 16-word sentence on the hypermedia program. They clearly expressed their opinions that they liked to work on the computer program rather than the book story even though they could not type fast. The findings support the previous discoveries of self-exploration and interaction with the program that the learners spent more time interaction with the program and wanted to explore more content and words than what had been designed in the program (Zhuo, 1997).

This study also confirms that a native language can be very beneficial to second language acquisition or foreign language learning when used appropriately. Used just as learning aids, Chinese sounds and characters help the Chinese learners, especially student H and R who had been in the country for about a month, understand the content. The results of this study matches the findings in the previous self-exploration study that the Chinese ESL learners spent less time to view and listen to Chinese pages and navigated to the Chinese text when they needed help. Therefore, teachers can use learners' native languages to help instruction and learning when necessary, and should use as little as possible.

How This Study Informs Teacher Training

Pre-service teachers should receive training in a wide range of areas. For example, they should become aware of the children's positive attitudes toward computer which can increase learning. The ESL students in this study all agreed that they enjoyed using the computer. As the word-processing software makes editing easier and the learners preferred to work their first draft on the computer instead of pen and paper.

In this study, two young students, a Japanese and a Korean, talked less about the pictures and expressed much less about their opinions in the interviews than the Chinese students. Sometimes, the Chinese students could ask or answer questions in Chinese in addition to the Chinese text and sounds in the software, so that they felt more comfort-

able than those two non-Chinese students in during instruction and interview. On the way between their classrooms and the staff room, the Chinese students talked with me in Chinese too.

Other findings may help prepare pre-service teachers so that they can integrate hypermedia or CAI into second language teaching and learning. Although authenticity of the child's work is very important, sometimes their drawings, for example, may not clearly depict an object. With the help of animation and sounds, the children had no problem at recognizing the car in the story, but some of the learners mistook it as a computer when they tried to tell the story from the picture in the book form. There was not, however, a problem after they were exposed to the animation and sound of the hypermedia program. Similarly, a child, at one point, considered that the children went back home instead of going to school. After learning the story, the learners repeated the story in their writing. To yield the best learning outputs, pre-service teachers should be taught how to encourage and prepare their future students how to master keyboarding skills so that the learners can spend most of their time on interaction and learning.

Pre-service teachers should also receive instruction on how to select or create software that provides writing and note-taking opportunities so that learners can learn through more sensory channels rather than just clicking forward or backward. In addition, pre-service teachers should be taught whether a holistic approach is effective for their specific ESL learners or not, especially when time is limited. Pre-service teachers should be shown how to guide and facilitate users' interaction with a hypermedia program, so that computers are not used for busy work. Such guidance and facilitation should also reduce navigation confusion and cognitive overload.

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Sibling-Mediated Literacy Learning by Home Computer Instruction

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Cooperative peer-mediated instruction where students serve as instructional agents for classmates is an old idea (Gerber and Kauffman, 1981). Peer teaching has been in existence since the 1800s. Research in non-computer learning situations supports cooperative approaches. Johnson and Johnson (1989) reviewed over two hundred students and found support for cooperative approaches. Research concerning peer-mediated instruction has also revealed the importance of peer interaction in work on computer problem solving (Joiner, Messer, Light, & Littleton, 1995). Newman, Griffin, and Cole (1989) point to the educational richness of collaborative computer work.

Some posit that student interaction may be responsible for the benefits of collaborative work. However, when considering interaction in technological contexts, besides interaction with peers one must include interaction between peers and the computer. In addition to or in lieu of interaction, peer presence may also be beneficial. Johnson, Johnson, and Stanne (1995) demonstrated that cooperative peer-mediated computer assisted learning was superior to individual or competitive approaches. In examining computer assisted literacy instruction among junior high school students, Mevarech, Stern, and Levita (1987) found that students who learned in pairs were more prosocially oriented toward their teammates, had stronger positive attitudes toward cooperative learning, and scored higher on achievement tests than those who learned alone.

However, little research in the literature has focused on peer-mediated computer instruction in preschool students. Chang, Rossim, and Pan (1997) report from their observations that when young children encounter problems that they are frequently directed to other children in the classroom. They advocate that timely adult developmentally appropriate intervention is also needed to prevent frustration and facilitate program use. Clements, Nastasi, and Swaminathan (1993) indicate that young children prefer working with partners. Virtually all of the research done in cooperative or peer-mediated learning has been school rather than home oriented. No study of sibling-mediated home computer instruction was noted in my review of the literature.

Preschoolers

Like most novice users, when preschoolers use a computer they are learning on two levels. On one level they are learning how to use the computer and on another they are learning the instructional content of the program. Thus, when using literacy programs, children learn both text literacy and the technology literacy (Reinking, 1994). Problems with computer operations can lead to frustration and an inability to learn from the program. Seifert (1993), Meehan (1985), and DeVoogd and Kritt (1997) all emphasize the inefficient learning strategies employed by young children and the importance of the assistance of adults or knowledgeable others. It is helpful for the preschooler to have immediate access to assistance when a problem occurs. Unfortunately, at home, just as in the classroom, adult attention to the computer may be scarce, whereas peer/sibling assistance may be more readily available. Given a context in which peers/siblings assist each other on the computer and the possibility that conflicts between the peers/siblings are likely, it would be helpful for children to learn some conflict resolution skills. Such social skills would benefit the children on the computer, parents, and teachers.

Benefits of Sibling-Mediated Instruction

Home literacy computer time should not be viewed as an alternative but as a supplement to other home literacy activities such as lap time reading. It is a worthy alternative to vapid videos and non-educational television viewing. One obvious advantage of siblings working together on the computer is that it makes what was an individual activity into a family activity.

Observation Outcomes

To apply some of the literature findings in a concrete setting, imagine a five year old girl was observed working independently on the computer. Initially a lack of reading and computer skills leads to difficulty in using the computer and general frustration. Later, when her eight year old

brother assists, changes surface in her interaction with and use of the program. Here are some of the possible benefits:

1) Less negative affect and frustration occurs with the sibling presence.
2) Greater persistence and longer periods of time are committed to each program. Meskill and Swain (1994) note that multimedia computer programs increase attention span. Also, as parents teach children the sibling mediated approach, the benefits of assisted performance are enhanced.
3) More directed program appropriate activity occur (less random mouse clicking); less activity is directed solely toward stimulation without regard to programmatic questions or goals. Sibling assistance resolves some similar difficulties noted by DeVoogd and Kritt (1997).
4) A general increase in computer skills and ability to resolve problems independently is observed.
5) Greater knowledge is gained from the program. Initially, the older sibling is instructed to give help only on computer problems and allow the younger children to make their own program mistakes. Once the parameters for appropriate assistance were clear, the facilitated learning experience enhanced achievement.
6) The older sibling consolidates to become able to verbalize his computer skills and knowledge when providing explanations to the younger sibling.

These benefits appear to transcend different literacy programs and various program types. Recent theorization concerning peer-mediated learning tends to take a Vygotskian or Piagetian perspective (Joiner, et al., 1995). These perspectives posit benefits from the interaction of peers concerning the instructional content. Another benefit accrues from an increase in what Vygotsky (1978) would call the zone of proximal development (ZPD). DeVoogd and Kritt (1997) emphasize that software should be chosen in the ZPD, the distance between current and potential functioning what the child can do with assistance. This goes beyond meeting students where they are toward posing problems just beyond what they can currently do alone.

The computer alone can functions as a scaffold to support student work at a higher level than they are able to achieve by themselves, peers or siblings at home can provide the required assistance to serve as a bridge to potential functioning. Sibling assistance enables younger siblings to appropriately use a wider range of software. This facilitated use includes programs in which the younger child responds directly. Also, the siblings took turns using their favorite literary programs. The reinforcing nature of this companion learning is such that the younger sibling elect to stay and observe while the older sibling used more advanced programs. Thus the younger sibling further benefited from vicarious learning and the older brother's modeling on programs just beyond or at the outer limits of her ZPD.

Call for More Research

In a time when both parents work outside of the home and are as busy in the evening as they are during the day, it is likely that siblings frequently mediate home computer use. Formal empirical investigations should be undertaken to determine the parameters and benefits of sibling-mediated instruction. It would be interesting to contrast sibling-mediated computer instruction with parental and other peer mediated instruction.

While not empirically verified, it is likely that sibling-mediated instruction works best with siblings who get along well enough to play and work together without excessive conflict. There is some likelihood that positive interaction among siblings on the computer will transfer to other sibling activities, since classroom research indicates such transfer of skills with unrelated peers (Mevarech, 1987). Empirical research in the area of sibling-mediated instruction could lead to the development of guidelines for parents to structure optimal sibling-mediated computer learning experiences, conflict management, and software selection.

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Instructional Technology: Another Perspective for Pre-service Teacher Training

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Instructional technology has been emphasized in teacher education programs all over the United States. Federal government, state administrators, and local authorities have realized what an important role technology plays in today's instruction and learning in schools. NCATE has plugged the technology into the teacher education program review process. Many thousands of tax dollars have been granted to provide computers for schools, provide training for pre-service and in-service teachers, and conduct collaborative projects for the implementation of technology in education. According to the national survey report, 100% of all schools own computers and the ratio of computer to students has become 9:1 in the United States (Electronic Learning, 1993; Office of Technology Assessment, 1995). Abrams (1996) believed that there will have about 30 million CD-ROM drives sold by the year of 1999, and at least 2,000 CD-ROM, videodisc packages will be titled for education. The Education Department has projected that all children in the United States will have access to Internet in their classrooms by the year 2000.

The use of technology for learning starts from the elementary school, continues in the junior high school, and becomes sophisticated in senior high school. All these no doubt are positive, exciting, and enthusiastic. On the other hand, the course credit hours of technology training for pre-service teachers are limited, reduced, and even eliminated from some of the pre-service teacher education programs. It is thought that our pre-service teachers have been well prepared in technology when they graduate from high schools and so it is reasonable to believe that having a required instructional technology course in the program becomes redundant. What is the reality? Which direction should we go forward? Should there be more emphasis on technology training in teacher education programs or leave the technology training aside? The purpose of the study is to examine the truth of these statements.

Background

The presenter conducted a qualitative as well as a quantitative study at senior high schools within the state of Georgia and in Jiangsu province of the People's Republic of China in the year of 1996-1997. The state of Georgia and Jiangsu Province have a friendship dating back to 1985. The Governor of Jiangsu province visited Georgia in 1995, and a delegation of the University System of Georgia was invited to Jiangsu in 1996. Both the state of Georgia and Jiangsu Province are similar in many ways. Both are located in the southern parts of their countries, and have like climates. Both are experiencing rapid economic growth, with new construction and city revitalization. More importantly, to the teacher education communities, both realize and are promoting the use of technology to improve teaching and learning. The presenter was granted opportunities to interview principals and program coordinators, tour computing facilities, and investigate the use of technology with students in both ninth and twelfth grades in the state of Georgia and in the Jiangsu Province, China.

Three of the six schools were identified in the Jiangsu province of People's Republic of China. The other three were selected from the Cobb county, Georgia. Three identified schools in China are nationally recognized key middle high schools (7th to twelfth grades). Two schools are located in Nanjing, the capital of Jiangsu province, and one in a city about 100 miles away from Nanjing. Three schools selected in Cobb county, Georgia are located about 25 miles northwest of Atlanta, the capital of Georgia. All of them are academically considered good schools with higher SAT scores.

Methods

The subjects of the study were randomly selected from six senior high schools within the state of Georgia and in the Jiangsu province of People's Republic of China. 351 students in total were involved in the survey. One third of them were ninth graders and two thirds were twelfth graders. Eight administrators from the same six schools were interviewed. Five of them are principals and three are program coordinators and teachers. The survey questions

were centered on the students' level of computer literacy, and the time they spent using computers and watching TV. The interview questions were focused on the number of students and staff at each individual school, the number of computers available for use at those schools, and principals' perspectives of the use of the technology to improve the teaching and learning.

A descriptive statistics is adopted in this study. Median and range were used to calculate the time of use computers in school and at home. Mean and standard deviation were calculated for the amount of time students were watching television. The data from the interview were summarized for discussion.

Results

The results of the survey showed that 38% of 157 students in China use computers in school, and 19% of them use computers at home. 79% of 194 students in the United States spend time at computers in school, and 81% of them work at computers at home. The time that Chinese students use computers ranges from 0.1 to 24 hours with a median of 1 hour per week in school, and from 0.3 to 48 hours with a median of 3 hours per week at home. The time that American students spend working at computers ranges from 0.1 to 25 hours with a median of 1 hour per week in school, and from 0.1 to 50 hours with a median of 3 hours per week at home. About television time, 154 out of 157 students in China have televisions, and on an average they watch 4.77 hours per week (M = 4.77, SD = 4.32). 193 out of 194 American students watch televisions, and on an average they watch 11.21 hours per week (M= 11.21, SD = 10.43)

Table 1.
Number of High School Students Using Computers in School and at Home

Students		In School		At home	
		N	%	N	%
Jiangsu, China	157	59	38%	30	19%
Cobb, Georgia	194	153	79%	158	81%

Table 2.
Time of High School Students Using Computers in School and at Home

Schools	In School		At home	
	Median	Range	Median	Range
Jiangsu, China	1 hour	0 -24 hrs	3 hrs	0.3 - 48 hrs
Cobb, Georgia	1 hour	.1-25 hrs	3 hrs	0.1 - 50 hrs

Table 3.
Time of High School Students Watching Televisions

Students	Watching TV			
		N	Mean	SD
Jiangsu, China	157	154	4.77 hrs	4.32
Cobb, Georgia	194	193	11.21 hrs	10.43

In China, students mainly use computers to learn keyboarding, programming, and word processing in school. All of these are mandatory in the ninth grade curriculum. All ninth graders are required to take a technology introductory class, but very few students in the twelfth grade have time to work at computers. At home, they use computers to practice keyboarding, calculate, do homework writing assignments, and play games. In the United States, students mainly spend time at computers learning foreign languages, writing papers, and practicing keyboarding skills in the language labs, and conducting experiments in the science labs. At home, they spend time at computers playing games, searching information through the Internet, and completing homework assignments. The students, according to the survey, do not know much about instructional technology. The majority of them either spend time playing games at computers or completing writing assignments.

The data results from the interview showed that among three Chinese middle high schools, all computer labs are equipped with high quality computers, 486 and 586 IBM compatible computers. Some can run advanced CD-ROM software packages and multimedia applications. Only one school has one computer lab that is equipped with 286 IBM compatible computers. All teachers are required by the Jiangsu Province education commission to pass a preliminary computer competency test. Teachers pursue their training opportunities and take written and hand-on examination during the academic year or in the summer vacation. All students in the ninth grade have to take a required technology introductory course in the computer labs. Keyboarding, word processing, and basic programming skills have integrated into the ninth grade curriculum. While asked to give their perspectives of technology use in schools, Chinese principals and teachers are mainly concerned about the establishment of network, tests database, and management system. One of their short-term goals is to have one computer for each teacher and classroom, and to raise the ratio of graduates to pass national college and university entrance examinations.

From the interview with program coordinators and principals, and the tour of the computer facilities in three Cobb county high schools, the presenter found that there are more computer labs in these schools than in Chinese schools. However, more 286 IBM compatible computers sit

in the labs. In Macintosh computer labs, most computers are not equipped with the latest CPU system. In the PC compatible labs, most computers are 286 and 386 IBM compatible computers. Only a few of them are 486 or above with the capacity to run advanced CD-ROM software packages and multimedia applications in the labs. Talking about the perspectives of the use and development of technology in schools, the principals and program coordinators are mainly concerned at the plan of updating hardware and software in the labs, development of networking and Internet access, and the implementation of multimedia mediums and Internet into instruction.

Discussion

For several reasons, the presenter is more dismayed than delighted with the argument that our pre-service teachers have been well prepared in technology when they enter teacher education programs. First, not all students in high schools are frequently involved in the use of computer technology for learning in school and at home. The results of the study showed that only 79% of 194 American students spend time working at computers in school and 81% at home. Although there are more students who use computers in school and at home in the United States than in China, we still have about 20% students who do not know how to use computers at all. In the three middle high schools of Jiangsu province, China, every Chinese ninth grader is required to take a technology introductory course in school, learning keyboarding, programming and word processing skills. The reason few Chinese students in twelfth grade use computers in school and at home is that they are facing an extremely competitive national university and college entrance examination before graduation. They are more concerned about preparing for pen and paper tests than using computers. However, the technology skills they obtained when they were in the ninth grade will no doubt help them fit into the high-tech society of the future.

Second, most computers in the schools cannot meet the needs of sophisticated educational software packages. Touring the computer facilities of three high schools within the state of Georgia, the presenter found that most of the computers in the labs are 286 PC compatible or MAC IIc computers that cannot run sophisticated window and MAC applications. There are no computers in the classroom yet in Chinese schools, but in the school labs they have more advanced computers that can run newly developed educational software packages.

Third, not many students spend enough time using computers for learning. Few students have put a great effort to use computers in school and at home. The results of the study indicated a statistics of the range of 0.1 to 25 hours with a median of 1 hour per week for students using computers in school, and the range of 0.1 to 50 hours with a median of 3 hours per week at home. The study also showed us that among 194 students, the average time of watching TV is 11.21 hours per week. It is much more than the time of working at computers. The majority of students only spend 1 hour in school and 3 hours at home per week working at computers. Besides, we should realize that students use computers mainly for keyboarding drill and practice, word processing, and playing games. Few students have spent time using computers to learn about the computers, such as, programming, problem solving, and integrating technology for learning.

Conclusion

Technology-based systemic reform in pre-service teacher education is hard in part because our ways of thinking about the readiness of implementing technology in classrooms are often flawed. It is thought that pre-service teachers are well prepared in technology when they graduated from high schools. In fact, they are not! Most high school graduates do not know much about educational technology, nor have they had much practice and training in technology when they enter universities and colleges. With the limitation of computer facilities and time spent on the computers in high schools, they will definitely feel frustrated with the challenge of using computer technology for effective teaching and learning. For the 21st century, it is important for us to put more emphasis on a curriculum guided technology training for pre-service teachers instead of limiting, reducing the training hours, and eliminating technology training class from teacher education programs. Reality reveals that there is a necessity to have instructional technology training more heavily stressed in teacher education programs. Meanwhile, flexible modules of training should be explored to meet each individual's needs.

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A Web Link for the Teaching Mathematics in Early Childhood Education

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Integrating technology into the classroom has become one of the priorities of redirection in education for effective teaching and learning. In the United States, the Department of Education has developed an ambitious national technology plan. According to the plan, the nation must commit itself to achieving three major goals by the year 2000: (a) all 2.9 million teachers in America will have received technology training, (b) all 110,000 schools in the nation will be equipped with computers that are connected to the National Information Infrastructure, and (c) all schools will have access to affordable, high-quality, technology/content based software for achieving high academic standards (Office of Technology Assessment, 1995). The National Council for Accreditation of Teacher Education (NCATE) has also set the use of technology as a fundamental part of the teaching, learning, assessment, evaluation and productivity process (Hoadley, Engelking, & Bright, 1995). While it is true that teacher educators, teachers, and students need to know more about technology to achieve these goals, it is not clear exactly what assemblage of knowledge each group needs to know. To be more specific: (a) What does the World Wide Web mean to the teachers and students? (b) What is available on the Web for teaching mathematics in early childhood education? and (c) How can a teacher implement the Web resources into classroom instruction and learning effectively?

World Wide Web To the Teachers and Students

The World Wide Web, more than any other component in our lives, is showing the way of the future. According to Cafolla, Kauffman, and Knee (1997), the number of Web sites is growing exponentially and the number people using the Internet is doubling every year. The statistics show us that (a) there are 27 personal computers for every 100 people in the United States, (b) the number of WWW sites doubled every 53 days, (c) an estimate of the number of WWW sites as of July 1, 1996 has reached 17,956,841, and (d) .74% of the world's population, approximately 44,238,061 people, are on the Internet predicted by July 1, 1996.

As teachers and students, we now have the capacity to get on the Internet and to expand our intellectual lives to make our teaching and learning better than before. World Wide Web opens up a whole new world for teachers and students. Almost every institute in the world has its own Web site. In the United States, most universities, federal and state government agencies, public and private schools are now online. Through a Web browser, for example Netscape, teachers and students can point and click their way around the world. They can visit different places, collect information, experience visual and audio stimulants, communicate with others, see the future, and extend the intellectual world beyond the walls of the classroom (Cafolla, Kauffman, and Knee, 1997). The goals of 2000 encourage teachers to weave WWW into our curriculum and classroom.

The Internet access has become available. To a certain extent, the training has also become available. However, all those are mainly in the form of showing teachers and students the benefits of this information-rich medium (Caruso, 1997). Searching and identifying relevant sites through the Internet for specific subject teaching are extremely time consuming. Obtaining and capturing desired informative and applicable teaching ideas and activities from World Wide Web require even more endeavors. However, making internet access available in schools is not enough! Teachers and students need to know about the vastness of the information available to them. They must learn that many reputable sites and lots of unreliable sites exist on the Web at the same time. Then, what is available on the Web for teaching mathematics in early childhood education?

Available Web resources

Based on a search and evaluation, the author presents the following sites which may be helpful for teaching

mathematics in early childhood education classified into five categories:

1. lesson plans and instructional resources
2. literacy for teaching mathematics
3. children's learning online
4. teachers' forum
5. CD and software information.

Sites of lesson plans and instructional resources

The sites of lesson plans and instructional resources contain formal and informal lesson plans, instructional ideas, and procedures of classroom activities. Teachers who teach mathematics in early childhood education can copy, print and adopt those lesson plans, ideas, and activities for their own classroom use.

http://www.eduplace.com/math/mathcentral/gradeK/ksca1.html This site provides kindergarten teachers with an activity plan of teaching counting numbers. In this activity, children will write numbers on worksheets with picture of apples, and then show their understanding of the number's value by writing the corresponding number of seeds on each apple.

http://www.kconnect.com/kc-domino.html This site provides teachers with an activity plan using dominoes to teach counting numbers. More ideas and activities can be linked with the click at the linking word, dominoes, at the bottom of the Web page.

http://www.eduplace.com/math/mathcentral/gradeK/koca2.html This site provides teachers with ideas of teaching triangles, squares, and hexagons. In these activities, children will cover a picture with correct pattern blocks and then sort the blocks into groups of the same shape. Children will then make statements about the patterns using comparison words.

http://www.eduplace.com/math/mathcentral/gradeK/knca1.html This site provides teachers with an idea of using cube to make a cubes train in Kindergarten classroom. Children can learn to count numbers with this activity.

http://www.eduplace.com/math/mathcentral/gradeK/knca2.html This site provides teachers with an idea of using pictures and domino cards to teach numbers 1-9. Children will match the picture and domino correctly in the classroom activities.

http://www.missouri.edu/~c575812/mts/math/_link.htm This site is created by Shu-Chen Jenny Yen. She provides teachers with the ideas and activities to teach mathematics. The numeration section is very good for kindergarten teachers to adopt in the kindergarten mathematics classroom.

http://www.eduplace.com/math/mathcentral/grade1/101w1.html This site provides a coloring worksheet for first graders. Teachers can print out the worksheet for children to color and write numbers 1-12.

http://www.xs4all.nl/~spaanszt/Domino_Plaza.html This is the site to provide ideas and activity procedures for teachers to teach second grade mathematics. With these ideas and activities, children learn to add and subtract through playing domino games.

http://www.eduplace.com/math/mathcentral/grade3/301io.html This site provides a math center activity procedure for third-grade teachers to teach chart and graph concepts.

http://www.eduplace.com/math/mathcentral/grade3/302io.html This is an activity resource for third grade teachers to teach addition and subtraction with selling and preparing snacks.

http://www.klutz.com/treefort/travel/nim/nim.html This site provides an activity resource of playing NIM. Teachers can adopt the activity to teach addition and subtraction in the third grade classroom.

http://geo.arc.nasa.gov/esdstaff/jskiles/top_own/how_tall_that_is/how_tall_is_that.html This site provides an activity idea for teachers to teach estimation of the height of an object.

http://forum.swarthmore.edu/alejandre/magic.square/loshu1.html This is a story and addition activity site. Teachers can bring stories to class and have students do mental math to find out the magic sum with the numbers in a square mat.

http://forum.swarthmore.edu/teachers/ This is a site particularly suitable for elementary school teachers, from pre-kindergarten to grade 5. It is a good resource site of lesson plans and teaching activities that are classified into Pre-K, K-2, and 3-5 academic levels.

http://www.eduplace.com/math/res/parentbk/phs4.html This is a site to provide math activities for parents to help young children learn mathematics in real life environments (grocery story, restaurant etc.). However, it is also a good resource site for teachers to design and prepare homework assignments.

http://www.eduplace.com/math/res/parentbk/phs5.html This site consists of math puzzle activities to help children learn mathematics from grades K-6. Teachers can assign students different mathematics puzzles as homework assignments.

http://www.eduplace.com/math/res/parentbk/phs2.html Although this site is designed to provide parents resources and ideas to work with children in mathematics, teachers can cooperate with parents to create an outside learning environment for young children here. The resources are categorized into grades K-2 and 3-6 levels. At grades K-2 level, the links include: (a) numbers and estimating, (b) measurement , (c)shapes and patterns, (d) computation, (e) data and graphs, (f) numbers. At grades 3-6 level, the links embrace: (a) Computation and Estimation, (b) Fractions, Decimals, Ratio, and Percent, (c) Data and Graphs, (d) Measurement and Estimation, (e) Geometry.

http://www.srl.rmit.edu.au/mav/PSTC/general/index.html This is a site named as Mathematics Problem Solving Tasks Center. At this center, teachers can view the monthly mathematics problems started from the December of 1995. It also consists of wide links related to mathematics problem solving on the Web.

http://www.bobvila.com/conversions.htm This is a resource of conversion with measure, weight, metric system and English system, etc.

http://www.capecod.net/schrockguide/math.htm This site provides mathematics teachers with a link list to explore the Web resources.

http://www.cs.uidaho.edu/~casey931/mega-math/ This site contains unusual and important mathematics problems for teachers to implement into elementary school classrooms, so that young people and their teachers can think about those mathematics problems together.

http://www.aimsedu.org/puzzle/puzzleList.html AIMS puzzle corner is a site to provide teachers with monthly mathematics puzzles that were started from May 1995. Instructional suggestions, materials of activities are included.

http://forum.swarthmore.edu/elempow/solutions/index.html This is a site to provide teachers with weekly mathematics problems and solutions dated back to the October 1995. Teachers may explore the previous weeks' problems and implement them in their classrooms.

Sites of literacy for teaching mathematics

The sites of literacy for teaching mathematics provide teachers with the resources of books that can be read to the children in the mathematics classroom.

http://www.eduplace.com/math/res/parentbk/phs6.html This site provides the literacy resources for teachers and parents to read to children categorized into K-2 and 3-6 grades levels.

http://members.aol.com/jeff570/operation.html This is a reading resource about the mathematics symbols, including the history of each symbol.

http://www.eduplace.com/math/mathcentral/index.html This site contains good biography links for children's literacy of mathematics from kindergarten to six grade.

Sites of children's learning online

The sites of children's learning online give children opportunities to practice their learning with hands-on activities online. Playing on the Web, children will solve mathematical problems, join the discussion and engage in drill practices.

http://bright-productions.com/kinderweb/tri.html This site is a game for kindergarten students to identify shapes.

http://www.gold-pages.com/math/ This is a site for children to practice addition and multiplication skills by playing baseball. Three levers (easy, medium and difficult) give children choices and challenge. At the end of game, the score of each player is provided.

http://www.stack.nl/~raymondp/nim/ This is an on-line game of play with Nim. Players can take turns to remove stones from the piles, and the one who removes the last stone wins the game.

http://www.eduplace.com/math/brain/index.html These activities are categorized into grades 3-4, 5-6, and 7+ levels. The site includes previous week's mathematics problems, the solution to that problem, and current week's mathematics problem. Students can practice with on-line help and view solutions to the problems.

http://www.lifelong.com/lifelong_universe/AcademicWorld/MonsterMath/default.html The monster mathematics home page is designed to introduce and review a variety of basic math concepts such as counting, addition, and multiplication. Activities online allow the children to become problem solvers.

http://www.wwinfo.com/edu/flash.html This is a site of on-line mathematics flash cards. They allow students to setup their own levels for practice with addition, subtraction, multiplication and division.

http://forum.swarthmore.edu/dr.math/drmath.elem.html This is a site named "Ask Dr. Math." Questions and answers are all related to the elementary mathematics with multiple topics. Children can explore and post their own questions and get help from others all over the world.

Sites of teachers' forum

The sites of teachers' forum allow teachers to share expertise with other teachers and students, and to post questions and answers for the effective teaching and learning mathematics in early childhood education.

http://forum.swarthmore.edu/dr.math/drmath.elem.html This site allows teachers to post math questions and answers for sharing with colleagues all over the world.

http://www.pacificnet.net/~mandel/index.html This site provides teachers opportunities to help teachers. The site is dated back to September of 1995. In the Mathematics section, teaching materials and activities are posted on the basis of grade level and subject area.

Sites of CD and software information

The sites of CD and software information provide teachers and students with the information of current available CD and software packages on the market. Most of them are hosted by software companies.

http://store1-3.broderbund.com/products/fs-kids.html Hosted by Broderbund company, this site provides teachers and students with the company's latest information about the valuable mathematics and science software packages.

http://www.solutions.ibm.com/k12/solutions/tlc/math/mtm.html This site is hosted by IBM. It is a software package, "Measurement, Time and Money," that promotes

children's problem solving and thinking skills by building on three levels of understanding (K-4, 3-4, and 5-8).

http://www.forum.swarthmore.edu/shareware/shareware.by.topic.html This site provides teachers information about shareware, freeware, and commercial software packages for teaching mathematics both for Mac and IBM computers. The topics of "Arithmetic" and "Geometry" are particularly helpful.

http://store1-3.broderbund.com/ This site is about a software package, "Mouse Math." "Mouse Math" is a verbal mathematics drill program for Windows. It is a package with setup options that allow teachers to select problem ranges appropriate for young children, older kids, and teens.

An EASIER approach

Assuming mathematics teachers and students in early childhood education know how and why to navigate the Internet, and can get access to the WWW, what is next? To know what is available on the Web is important. However, more important is how teachers can integrate the Web resources into the classroom instruction for the effectiveness of teaching and learning. The presenter is likely to share an EASIER approach with teachers. The EASIER approach consists of E Explore, A Adopt, S Setup, I Implement, E Evaluate, and R Re-construct.

Explore

Unless one explores the Web resource, he or she cannot really understand the four "Ws" of the Web site validation. Four "Ws" include 1) who wrote the site? 2) What are they saying on the site? 3) When was the site created? and 4) Where is the site from (Caruso, 1997)?

Adopt

Exploring the Web, one will find which site is really useful for his or her teaching, and which information can be adopted for classroom use. If the information is selected, the teacher can make a copy or print out or add a link to his or her own Web page. He or she can have valuable Web resources adopted for use in classroom teaching and learning.

Setup

Clear and specific instructional objectives will help one to implement the Web resource effectively. A teacher should be able to have the curriculum to drive the Web resources. The Web resource should be implemented into the curriculum and for the improvement of teaching and learning.

Implement

With a specific instructional objective and valuable Web resources, a teacher can plan an implementation of Web into the classroom teaching, and determine when, where, and how to use Web resources to enhance their teaching.

Evaluate

Evaluation include two sides: 1) students' learning achievement, and 2) teacher's teaching effectiveness. The former is to see whether students improve their learning with the implementation of Web resource, and the later is focused on the assessment of the strategies of applying Web in instruction and learning.

Re-construct

Re-construction of procedure suggests we need keep our resources updated. Teachers should explore and adopt new and updated Web resources, revise the instructional objectives, modify the implementation strategies, and redesign assessment tools to meet the needs of teaching and learning.

Putting the EASIER approach into practice is not easily achieved. It needs a teacher's initiative to get access to the Web, spend time to explore the Web, evaluate and select the Web resources. It requires a teacher's creativity to setup clear, specific and measurable instructional objectives and design implementation strategies. It expects a teacher's self-motivated criticism to assess students' learning and his or her own teaching, and reconstruct his or her teaching with reputable and informative Web resources.

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Living Democratic Values: Multiple Voices in an Online Class

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Even though the democratic values of thoughtful and diverse expression are not developed in our teacher education classes, the use of technology and a commitment to these values in theory and practice can provide students greater access to expression and diverse thinking for preservice and inservice teachers. Of our most precious treasures, is our democratic heritage that claims the rights to participation and freedom of expression for all. Though we claim to cherish these values in word, neither teacher education nor PK-12th grade education have demonstrated a strong desire to nurture the development of these democratic values in practice.

Limited Sources of Knowledge in an Information Age

Traditional classrooms of the past and present are places where students sources of knowledge have been limited to teacher lectures and reading from a single textbook. Even the physical structure of the classroom has been shaped to reflect the importance of teacher and textbook knowledge to exclusion of other sources of knowledge. In universities as well as in other schools, classrooms have been shaped with desks separated and facing the front to minimize student conversation and maximize attention to the teacher (Cuban, 1984) and to books. The students' purpose was to soak up as much information as possible from the teacher and the text. However, this type of education has been referred to by reformers as passive and dull (Cohen, 1988; Freire, 1970; Goodlad, 1984). In John Goodlad's (1984) book entitled *A Place Called School*, researchers saw students passively listening, reading textbooks, completing assignments, and rarely initiating anything despite stated school goals that stressed curiosity and involvement.

Other researchers similarly report that telling and accruing information dominates the classroom (Cohen, 1988; McDiarmid, Ball, & Anderson, 1989). This traditional approach incorrectly views the concept of "knowledge" as something that is static, unpersonal, and without perspective. By treating knowledge as a static, unchanging entity, teachers are really misrepresenting its true character. Knowledge is actually revisionary and pluralistic in nature (Schwab, 1978). The revisionary nature of knowledge is evidenced when individuals change their minds or develop a new theory which alters the old knowledge. Knowledge is also pluralistic in nature. Not only do people revise their individual knowledge, but they also may read and understand texts and experiences from different perspectives. We don't expect people of different philosophical, educational, cultural or socio-economic backgrounds to interpret the same text in the same ways. Even the most conservative critics would have to admit for example, that Catholics, Quakers, Pentecostals, Calvinists, Amish, and Eastern Orthodox churches have all interpreted the Bible in ways that make their worship different from each other. A flexible understanding of knowledge is very difficult to explain to students in a "telling" style of teaching. To gain a flexible multi-perspective understanding of knowledge student have to work with the knowledge, create it, and relate it to other types of knowledge and yet this activity is limited even in teacher education.

This relationship of teacher and textbook monopoly over knowledge and power in schools has persisted throughout this century. For example, Cuban (1984) discusses how stable teacher-centered practices were in his book detailing the stability of classroom practice from 1890 to 1980. He described a professor who studied rural schools in Texas in 1922 and found that in 88% of the classes the textbook and teacher were the primary sources of information. Typical dialogues between teacher and student consistently followed a similar pattern: teacher question, student answer, and teacher evaluation (Cazden, 1985; Mehan, 1988). Although Cuban finds that for short periods of time educational movements shifted educational practices away from teacher-centered instruction, his conclusion is that there has been no significant change in teaching practice this century. In other words, the measure of the students' goodness is the amount of facts they know, even though standardized tests are criticized for only being able to demonstrate *what* a student knows and not *how* he/she knows it.

Limiting Knowledge as a Way of Mediating Power Over Students

Controlling knowledge in a school is also a way of mediating the relationship of power by the teacher over the student. For some educators, the purpose of schooling is to teach a particular collection of knowledge, as claimed in Hirsch's (1987) book *Cultural Literacy*(1987) and Bloom's (1986) book *The Closing of the American Mind* Many times these particular compilations of knowledge imply value systems that are not shared by all individuals because of their culture, socio-economic level, or religious background. These sets of knowledge are culture-bound and particular cultural groups have an advantage in schools where the content of the knowledge the parents teach matches that of the school (Heath, 1983).

In universities and schools, so often we, as teachers and professors, demand students accept our version of the truth or we impose a textbook version of the truth to the exclusion of the child's personal knowledge and personal voice, and to the exclusion of other voices that are not mainstream enough to qualify for inclusion into textbooks. We have wanted students to accept the power the printed word has over them (Scollon, 1988). Students of all levels often get the impression that what is written in the textbook is more authoritative and relevant than that which they have heard spoken by their friends or relatives. Because of the authoritative style in which we present and test students on textbook and teacher knowledge, the sanctioned school knowledge has supremacy over student knowledge.

In schools we expect students to accept a position of submission in respect to content in classrooms, but this forced relationship does not have to exist. Constructivists have a vision of schooling where inspired students use personal knowledge in the classroom and express their voice as an equal scholar in the classroom (Cognition and Technology Group at Vanderbilt, 1992; Dwyer, Ringstaff, & Sandholtz, 1991; Newman, 1990; Papert, 1993). They claim that teachers should not just transmit information that students receive. These theorists emphasize student construction and coordination of effective problem representations (Daiute, 1985). Students need repeated opportunities to engage in in-depth exploration, assessment, and expression of their ideas over extended periods of time.

With constructive approaches, students who engage in generative rather than passive learning activities recall that information more readily because the information is created and used. In contrast, teachers who simply transmit knowledge to students will find that their ideas are inert and not as easily recalled. In a classroom where construction is important, information from various sources *are constructed as they integrate with student voice and personal student knowledge.*

Four Reasons for Allowing the Personal Voice

In search for this vision of schooling that promotes the democratic value of voice, four issues are central. First, when teacher and textbook information are used to the exclusion of student knowledge, a richness of knowledge that reflects personal knowledge and diversity that otherwise would not be present is missed.

Secondly, student voice and self-expression are concepts that allow the student to maintain a sense of identity and uniqueness while they are learning specific content. The student voice affords students a sense that they can connect school content with their goals and purposes in life. Dewey (1938) emphasized the role of individual knowledge and experience. Most knowledge in schools is imposed from outside the experience of students in a static, matter of fact way. What Dewey calls the "traditional approach" does not invite the student to challenge, edit, or modify information presented.

Third, duplicating teacher and textbook knowledge is a *passive process* that only teaches students to be docile and obedient to authority. As a method of learning, this passive process trains our young people to be dependent learners who need the direction of the teacher to progress. This type of thinking keeps students from constructing personal divergent thoughts that are important to a liberal education. Passive learning is also unexciting (Goodlad, 1984) and does not provide the sense of personal freedom and creativity that is vital to foster a feeling of ownership with the learner. That sense of ownership involves the learner to give them the critical element of motivation necessary to learn complex strategic processes (Paris & Oka, 1986). In constructive learning, students gain the will to do the skill.

Finally, when students accept teacher and textbook knowledge they often merely duplicate the teacher's schema while holding onto their own schema. Some call this duplication of the teacher's schema as replication, as opposed to an integration of personal and school knowledge, called restructuring (Roehler, 1989). Students accommodate the school schemas to help them survive the educational rites of passage and then revert back to their own schemas when they leave school. Knowledge in a child's life becomes unnecessarily compartmentalized and students find it difficult to access their prior knowledge dependent upon the context they are in. School knowledge is used at school; church knowledge at church; knowledge about friends with friends; practical knowledge is used in other places. School knowledge does not become integrated into personal experience coming from other contexts. Hence, copying school schemas leads to only temporary and not truly educative experiences.

Contemporary educational reformers believe that students should not *passively* accept information from the

teachers and textbooks. Instead, they should constantly monitor that information against their own existing knowledge and integrate the synthesis of those two into their own schemas (Garner, 1988). Some reformers look for teachers to provide adventuresome teaching (Cohen, 1988) or perhaps adventuresome learning that allows for students to initiate projects, drawing on many sources and constructing new information from what students and their classmates experience (Gardner, 1993). As students and teachers learn to use the computer to construct knowledge this way they provide avenues for educational reform (Papert, 1993).

In this section, some of the reasons why it is important for teachers to include personal knowledge and multiple voices in the schools instead of simply asking students to accumulate facts were discussed. College instructors can serve as good models when they ask students to consider knowledge critically. The next section provide an overview of a study in which college students in a graduate teacher preparation class used many sources and reflected many voices in the course of their online class.

The Study

This paper reports on some findings analyzed as a part of a larger forthcoming study that seeks to describe elements of learning that reflect democratic values in an online class. Ten graduate students took the introductory course in early childhood education in an online class over the course of a five week intensive summer course. With the exception of three face to face introductory meetings and an end of the semester summation meeting, four days a week we met asynchronously online through a series of email messages on the same day. A schedule of readings and activities were posted on the web as part of a syllabus.

In the larger study, student postings, student interviews, the researcher's log, the syllabus, and online discussion all served as data to describe the online teaching experience for these students. The data was analyzed using the constant comparative method (Glasser & Strauss, 1967) and with qualitative methods drawing on ethnographic research (Bogdan & Bilken, 1982; Erickson, 1986). Through readings and using software entitled Nudist, categories of data emerge and are tested for triangulation and with disconfirming data. The larger report is written to describe in rich detail the breadth and depth of the experiences found in the data.

For the class these beginning graduate students were required to participate in a range of activities on and off line all of which contributed to sources of knowledge they were able to post on our listserv. Students were required to read four books (one on the project approach, one on the workshop approach, one on thematic and one concerning the lived experience of a first grade teacher) and all the postings on the listserv. They were also required to spend 20 hours visiting classrooms to understand a range of what teaching means to different teachers. The videotapes of workshop and project approach which were to be viewed in the library, gave students a visual and practical understanding of those innovative methods. Students were also required use the project approach to teach children skills in context of the project experience. Finally, students had to post a two page critical response and two one page responses which most students did at home. The web page also provided several outside sources of supplemental information with web page links, examples of past student work, and other scholarly resources. So, in addition to the online portion of the class, students performed in a variety of ways which were designed to contribute to their understanding of teaching young children.

One of my objectives of the course was to develop an appreciation for scholarship that originates from several different sources including personal sources. To achieve that goal, students were asked to critically respond to: (a) the text readings, (b) their personal thoughts, (c) their field experience, (d) their viewing of videotapes of early childhood classrooms, (e) comments I, as the instructor, posted on the listserv, (f) ideas that I posted on the web page for each day corresponding to each of the day's readings and (g) each other's postings. Instead of responding to only the teacher and the text, which is typical in many teacher preparation classes, I asked students to respond to many sources.

Students responses to each other's posts created a sort of online discussion which was archived on a web page so anyone could follow the critical posts and the students' responses to the posts. I valued the texts which gave the discussion some focus and insight which was not available from the other sources of knowledge mentioned above. When I was planning the course, I also felt that the readings lend a depth and rigor of thinking that was not available in the other sources of knowledge. Even so, while keeping students responsible for daily critical essays responding to the readings wasn't enough. To truly engage students in a *critical* response to ideas in the text and outside of the text, I encouraged multiple voices originating from the student's personal experiences, field experiences, videotapes, other listserv comments, and myself.

The Data: Multiple Voices as a Democratic Value

Space for this article does not allow for the entire analysis of the multiple voices that emerged from the online class, however, for the purpose of illustrating some of the finding, I will examine one post written by Linda, one of the students in the class. Having pursued an unappealing career in business, Linda with no experience in the schools was attending class to become a teacher of young children. In her mid-twenties, she had strong opinions which I had not noticed in the previous class which I had run in a more traditional lecture/student presentation style. This was her second class in early childhood education.

As you read the section below, look for evidence of the origins of multiple voices such as other listservs, Linda's own thoughts, Linda's experience, and an invitation to hear other voices on the topic.

From: "Linda" <Linda@uh.edu>

> Re: Welcome to PBLNEWS: #3 Einstein and Project Based Learning. This article starts off with a quote from Albert Einstein: " Imagination is more important than knowledge." How true this is. A person can acquire all the knowledge in the world, but if they do not know how to apply that knowledge, then what is the point in knowing it. The problem with this type of person is that they were taught in such a manner that they never had to use the information that they were learning. Their purpose for learning was so that they could regurgitate the information on a test. Last semester, I had to work closely with this type of person. She aced tests, created great projects, and did very well academically. However, when it came time to apply what she had learned in a real life situation, she was unable to do it. I wondered how can a graduate student be so smart and then not be able to perform. I came to the conclusion that this was a skill that she had not been taught in her education. She had been taught that information used to perform successfully at academics, not to be used in real situations. As educators, we must teach our students to use the knowledge that we are teaching them. The article (I read points out) that this is a skill that we must "develop" in our students. One of the approaches mentioned in the article for developing this skill was projects. I have not read much about this approach. Has anyone used this approach or seen it done? I would like to know more about how this develops the skill of analyzing problems and developing solutions.

I want to highlight three pieces of information coming from the posting from Linda above that provide evidence that Linda was using multiple voices as sources of knowledge for this online class. At the beginning of Linda's post the entry listed after from (Re: Welcome to PBLNEWS: #3 Einstein and Project Based Learning) indicates that Linda responded to a post from another listserv called PBLNEWS that was posted on to our own class listserv for all in the class to consider because the post related to the topic of project based learning. This difference source, not commonly found in traditional university classrooms, found a voice inside of our class when it was posted, read, and responded to by Linda.

The second piece of evidence of multiple voices comes from Linda's reference to a fellow student whose knowledge from university courses so static and inflexible that she could not apply the information in real life. This bit of information, drawn from Linda's real life experience, gives voice and examination to an experience that might not have otherwise been considered in a traditional class which severely limits student opportunities to express their ideas. Unlike the spoken word in class, the written word online allows students more time and space to develop a well thought out argument. In contrast to papers turned in and to be read only by the professor, Linda's comments become public to be read by the professor and other students in the class. These thoughts are meaningful not only in the sense that they influence the student and the professor's thoughts, but also in the sense that they influence the ideas of other students in the class.

Thirdly, Linda requests help from others who might have understanding of this approach (which was to be studied later in the class). The shift in authority and power relations implicit in her queries is profound. Linda shifts from one who is required to learn a narrow range of information from the teacher and the text which is common in traditional university classes, to an inquiry orientation that requires her own initiative to ask about and solve. Linda asks other students if they would provide information which also engages the rest of the class in inquiry. This learning shifts the student role from passive recipient of information to creator and investigator of knowledge (Freire, 1998). Not only does this sense of curiosity and control of one's knowledge promote democratic values of voice, inquiry, and independent judgment, it also fosters the value of lifelong learning.

As a professor that seeks to empassion students about early childhood teaching in class, it was exciting for me to read the passion in Linda's voice that had been missing the previous semester. I don't believe it was so much Linda that had changed as much as it was the vehicle for communication in the class. The online class provided spaces and time for Linda, who seemed shy in a traditional setting, to give voice and passion to issues that were hidden in the more traditional classes.

Conclusion

This paper provides some background of traditional classrooms in which the range of content and voice is limited to that of the teacher and the text. Diversity in voice and information is a democratic value that is important not only because teacher education classes should be democratic in nature, but also so that teachers can live a model of democratic learning in their own future students.

Online classes, by their structure, providing time and space for diverse student voice and by the instructor's encouragement, can serve to promote democratic values. In the case presented, Linda's post gives the reader a window into the use of three different sources of information she uses to emerge as a knowledgeable teacher. Her comments online reflect ownership, voice, independence, and a sense

of inquiry that is not evident in traditional classrooms. If democracy is a value we cherish in our country, we need to encourage the norms and ways of being that reflect a democratic character in our own classrooms. Wise use of technology can play an important role toward that end.

Future papers will report more on giving voice as well as other democratic values such as the importance of time, styles of learning, active engagement in the subject matter, and modes of thinking and expression.

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VOLCANOES TO "VIRTUAL TOURS": BRINGING MUSEUMS TO CHILDREN VIA VIDEOCONFERENCING

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Museums are taking on a more active role in the education of children. Teachers have become more aware of this role and the benefits that informal settings can provide (Martin, Brown, & Russell, 1991). Science museums and other informal science centers such as zoos, aquaria, and environmental centers have increased in popularity because they provide opportunities that extend beyond the traditional static museum. These types of environments provide direct, interactive experiences with relevant materials that enhance students' curiosity and wonderment about science (Falk, Koran, & Dierking, 1986). According to Ramey-Gassert, Walberg, and Walberg (1994): "Museum learning has many potential advantages: nurturing curiosity, improving motivation and attitudes, engaging the audience through participation and social interaction, and enrichment" (p. 351). Thus, educators are incorporating participatory science museums and other non-traditional classroom settings into their curriculum to provide kinesthetic and visual experiences that cannot be duplicated in the regular classroom with the same outcomes (Falk, Martin, & Balling, 1978; Flexer & Borun, 1984).

With this growing utilization of informal environments, the assumption would be that the canon of research supporting their use has increased as well. However, Schauble and Bartlett (1997) concluded in their search for research-based museum designs that there is an incredible discrepancy between research on museums as an actual learning contexts compared to studies on exhibit evaluations within the museum. They state:

> Although more and more museums are incorporating research, too often research is framed by museum staff and funders as "evaluation," that is, as a way of demonstrating the success of a completed project, and not as a compass for guiding the unfolding design (p. 791).

They also note that even though there are many current sub-fields organized around school learning, such as educational psychology and instructional psychology, there is currently no sub-field that is generating the constructs and methodologies associated with informal learning.

Whereas research on galleries designed with appropriate pedagogy is limited, there is a significant amount of information on the behaviors children exhibit while attending informal science settings. In particular, the behavioral reactions to setting orientation and novelty influence has been examined extensively. This has led some researchers to be concerned that the novelty, or excitement of a field trip, may interfere with task-directed learning. Children spend more energy orienting themselves with the environment than trying to understand the scientific concept being presented (Falk, 1983a). In fact, some studies suggest that extreme novelty could even lead to less exploration and fear (Falk & Balling, 1982; Falk et al., 1978; Martin, Falk, & Balling, 1981). Researchers have conducted investigations to determine if purposeful novelty reducing procedures such as advanced organizers, or pre-visit, post-visit and on-site visit materials affect students' conceptual learning. Falk (1983b) researched whether orienting materials could be useful in producing more successful learning of museum information. These orienting materials include: logistical layouts and agendas given pre-visit, information panels placed anterior to museum exhibits, teacher pre-visit discussions, cognitive preparation materials related to the exhibits, and slide-tape presentations given pre-visit.

Technology Use in Museums

This last form of novelty reduction provided the catalyst for a research study. Kubota and Olstad (1991) introduced a pre-visit novelty reducing treatment via a slide tape presentation of the logistics and highlights of a science center. Their positive outcomes suggest that two-way audio-visual interactive learning (2WAVIL) technology could produce similar results. This relatively new form of communication has traditionally been used in the business sector as a type of videoconferencing. However, it is beginning to emerge in educational uses, starting first in Europe at the university level (Bork, 1995). The majority of research on 2WAVIL use focuses on this implementation

throughout the university realm. Few projects investigate applications at the high school level and virtually none exist for the middle or elementary school (Evjemo, Eidsvik, & Danielsen, 1995). Many of the studies report on cooperative ventures among schools in which one district hires a teacher to broadcast lessons via satellite or cable telephone lines to other cooperating schools. This is often accomplished in a very didactic manner with little interaction from the students (Bork, 1995).

The Children's Museum of Indianapolis is an institution that possesses 2WAVIL technology. As part of Ameritech's Advanced Video Network's "Vision Athena Project", it serves as a distance learning content provider to schools, businesses, and other community organizations throughout the state. As with most museums that possess this technology, the distance learning curriculum is implemented without a firm body of research as its foundation. Therefore, some informal learning environments have begun collaborative efforts with university institutions to investigate the possibilities of this technology.

The remainder of this paper is broken into two parts. The first addresses the research study that is currently being implemented at The Children's Museum of Indianapolis regarding the use of 2WAVIL technology as a medium for preparing students for a visit to the museum. The second portion of the paper includes descriptions of various school programs and initiatives that are currently being implemented by the museum. These programs use the 2WAVIL technology as a means of sharing museum resources and exhibits with elementary students.

The Research Study

Purpose

The purpose of this study is to examine how children and their classroom teacher interpret a visit to an informal science museum (The ScienceWorks Gallery of The Children's Museum of Indianapolis) following a two-way audio-visual interactive learning (2WAVIL) link. This "Virtual Tour" via videoconferencing technology is meant to serve as an advanced organizer for children, whom, according to research, often find an experience in museum settings overstimulating. This overstimulation often prevents an appropriate orientation to the new setting; such an orientation would help children focus on the concepts being presented by museum exhibits. This study intends to add to the literature by examining the influence of a 2WAVIL link on children's "lived" experience at an informal science setting.

The Research Questions. Specifically, this study addresses the following questions:

1. What are children's interpretations of their experience in a novel science museum setting and the 2WAVIL link which preceded it?
2. What is the classroom teacher's interpretation of those children's experience?
3. How do the children's and teacher's interpretation of this experience compare?

Design & Procedures

This interpretive study involves four fifth grade children and their classroom teacher as key informants. Data is gathered through interviews with the key informants, as well as through observations, field notes, and researcher reflections. Data will be interpreted through the development of common themes generated from the interviews and will be synthesized into assertions about the nature of the experience. These assertions will be triangulated with the other three types of data to strengthen the nature of the study. Member checking techniques will be employed with the classroom teacher as a further means to verify interpretations.

This study follows a phenomenological theoretical tradition. According to Patton (1990), the central question of phenomenological research is "What is the structure and essence of experience of this phenomenon for these people?" (p. 88). The research questions for this study fit within that question as the participants interpret the experience of their interaction with technology and with the museum environment. Interviews are utilized as the primary data source. An interview is conducted with the key informants following the initial observations but prior to the 2WAVIL link. A second interview occurs immediately following the 2WAVIL link but prior to the museum visit. The third and final interview sessions occur following the experience at the museum.

The classroom and the key informants are observed at least once prior to the visit. This helps provide general background knowledge on the dynamics of the class, the students, and the teacher. The key informants are also observed during the 2WAVIL link via a video recording of the procedure. Tracking of the key informants (a form of observation employed by museum personnel) is utilized during the actual visit to the museum. Key informants are tracked from a non-obtrusive distance by assistants. These assistants record data such as: the path of movement throughout the gallery, exhibits that were explored ("attraction"), amount of time spent at those exhibits ("holding power"), interaction with other visitors or classmates, and comments made related to the exhibit. Key informants are made aware of the tracking procedure to avoid anxiety that could be produced if children felt they were being "watched" by a stranger. Assistants are provided with a stop watch and a set criteria for how to track the key informants.

The data obtained from the tracking procedure are used as field notes. Also included in those notes are observed behaviors of the key informants in the other phases of this

study. Examples of such behavior would include: reactions of the key informants to classroom discussions and activities prior to and following the 2WAVIL link, behaviors observed during the actual link, and behavior displayed during the interview process. In addition to these field notes, personal reflections following observations, interviews, the 2WAVIL link, and the museum visit are recorded. Reflections are interpretations of: why students behaved in a particular manner, why students responded to various interview questions, what parts of the study went well, and difficulties experienced during the study.

Results & Findings

A qualitative approach to this project was utilized to provide information regarding the nature of the experience as interpreted by the participants. Final results and conclusions, at this point, are still pending. However, preliminary review of student and teacher interviews would suggest that the technology was effective in orienting the students to the gallery environment. While the degree of orientation varied from student to student, all four expressed that they felt the link was a positive experience. All agreed that one of the biggest benefits was that the technology enabled them to be aware of the types of exhibits that were in the gallery. They also felt the explanations of possible means of interaction and explorations, which were shared in the link, were helpful. When asked to compare the 2WAVIL link with a video-taped tour of the gallery, all emphasized that the ability to ask questions and interact with the tour guide "on the spot" would make a 2WAVIL link more motivating. These same reflections were shared by the classroom teacher who also believed that this was one of her most successful field trips. She believes this is so because many of the students came prepared with a plan of action for their visit.

The final results and conclusions of this project should help provide a better understanding of how children think and learn in informal science settings. It will also help extend previous studies done on novelty reducing preparation in informal learning environments. Additionally, this particular project will also serve as one of the few studies that examine the outcomes of 2WAVIL technology use in a classroom and in an informal setting.

The conclusions drawn from the project will have implications for the educational establishment's current push toward the integration of advanced technology in the classroom. It will provide a basis for further studies that implement distance learning technology. It will also provide information for schools and museums that are just beginning to equip their buildings with 2WAVIL technology

Videoconferencing School Programs

Developing 2WAVIL Programs That Follow Constructivist Epistemology

Bitgood, Serrell, and Thompson (1994) highlight the advantages that informal learning environments have over the traditional classroom. These sites are often able to meld affective and cognitive learning experiences as academic enrichment occurs via recreational interactions. Another advantage is that "time-on-task", while usually short, episodic and more intense than a traditional classroom, is controlled by the learner. Thus, participants are more apt to pursue those exhibits which possess science content that is relevant and meaningful to them. Schauble and Bartlett (1997) explain that this constructivist notion provided the theoretical framework for the design, construction, and educational programming of the ScienceWorks Gallery. Exhibits were created that could "build upon and extend activities first encountered at the museum into other contexts, such as the child's home, school or backyard"(p. 784). In addition to the physical design, the museum recognized that to truly encourage a constructivist approach, involvement with the exhibits must occur with mediation. This mediation needed to expand beyond the built-in components of tools, signs, and layout to include the even more important element of human interaction. Gallery interpreters are encouraged to be sensitive to the manner in which children think and learn while visiting exhibits. Less emphasis is placed on dissemination of factual content, with a greater significance being directed toward the pedagogical methods necessary to guide children toward science understanding. In short, the museum wanted to apply classroom constructivist methodology to an informal science environment.

While the museum has experienced a great deal of success executing these beliefs for their on-site visitors, the addition of audio-visual videoconferencing as a means of presenting museum resources adds another, more complex layer. Can an informal environment, built upon a foundation of free-choice exploration with guided interpretations, promote meaningful and relevant experiences for school children via electronic means? This notion of independent exploration would not seem feasible in a situation that requires students to remain mostly stationary and fixated to a central object of information presentation, the TV monitor. However, Jones and Knezek (1995) state that one of the true benefits of 2WAVIL technology is the "interactive" nature of the system. It provides a level of intimacy in communication that is not apparent in other forms of distance learning. Colbert, Voglimacci, and Finkelstein (1995) highlight that another strength of the technology lies in its synchronous nature; the teacher and learners experience parallel delivery and reception of information without a time delay. Finally, Jonassen, Davidson, Collins,

Campbell, and Haag (1995) suggest that a constructivist epistemology can indeed be implemented through 2WAVIL technology. They state:

Two-way real time video transmission of information implies a new definition of real-world context. Although video-mediated, constructivist learning environments could potentially include the actual environment or a close facsimile with which the learner could remotely interact. The collaborative problem-solving situations enhance knowledge construction through the addition of visual information and remote interaction with other learners. The video transmission of authentic, realistic contexts add a significant dimension to anchored instruction and situated learning environments (p. 18).

Technology Capabilities at a Children's Museum

The Children's Museum of Indianapolis possesses the capabilities to provide the actual museum environment in realistic contexts. Many institutions utilize a stationary audio/video set-up isolated in a single conference room. While the museum does have a dedicated distance learning classroom, it also possess a mobile camera and monitor unit. This unit can be plugged into fifty-four different receptacles located throughout the five-story gallery spaces and collections department house in the basement . These receptacles are wired to an in-house cable network located on the third floor. This central network serves as the head-end from which all broadcasts are received and transmitted via fiber optic phone lines. This has provided the museum the capability to broadcast and receive transmissions from almost anywhere within its 250,00 square foot facility. Thus, any of the museum environments can be brought virtually to schools or classrooms that own the appropriate equipment.

Creating 2WAVIL Programs at a Children's Museum

Possessing the capability to provide the museum environment to remote locations does not guarantee that interactive teaching techniques will be executed in a manner consistent with constructivist epistemology. Appropriate mediation would need to occur to avoid a didactic approach or "talking head" mode of presentation. Therefore, the museum is currently in the process of creating and adopting various distance learning science programs that can be transmitted to elementary and middle schools. These programs attempt to combine museum resources (such as gallery exhibits, collections and museum personnel) with a theoretical framework that models constructivist classroom teaching. What follows in the final portion of this paper are brief descriptions of some of the 2WAVIL school programs currently offered by the ScienceWorks gallery. These programs are approximately one hour long and are geared toward an elementary and middle school audience, with most emphasis in the 2nd-6th grades. In addition to explaining the content presented, a description of the manner in which these programs encourage guided exploration is included.

Lots-n-lots of Fossils

As one of the first programs designed by ScienceWorks staff, this lesson utilizes the gallery's twenty foot fossil wall which is modeled after a limestone outcrop from southern Indiana. Imbedded within the Paleozoic rock layer are realistic invertebrate fossils such as: gastropods, crinoids, blastoids, horn coral, and trilobites. Actual examples of these fossils can be found in the limestone quarry directly beneath the wall. For this presentation, the gallery camera becomes the eyes for the remote site. The fossil exploration can be controlled by the distant students who direct the on-site camera "to the left, up a little, now zoom in". With interpreter mediation, these fossil samples can be compared to the data sheet that has been faxed to the remote school prior to the link. Additional comparisons are made to a "What They Looked Like" wheel located near the wall. This spinning manipulative contains illustrations of the fossil life form as it looked when it was living. Interpreters are encouraged to promote discussion among the remote site students by having them share their ideas of the fossils that they discover in the wall.

Volcanoes: An Explosive Experience

Manipulation of tactile objects and "real" science equipment is imperative to fruitful interaction for on-site visitors. In developing distance learning programs, museum staff felt that remote students needed to be provided with these same opportunities. For this program, kits which contain samples of volcanic rock and materials necessary to "produce" volcanic eruptions are prepared and sent-out to participating schools. The program begins with a discussion of the basic geologic structure of the earth. An explanation of the various types of volcanoes and a demonstration of volcanic eruptions then follows. The interpreter provides step-by-step instructions to the students who are placed in 3-4 cooperative groups. A variable is changed for each group which produces a difference in the type of eruption. Students discuss the reason for the variance in reactions among their groups and with the interpreter. The program continues with the presenter guiding students in an investigation of the physical properties of the rock samples. Students record observations of their samples (i.e. color, texture, mass, buoyancy, etc.) and compare them with observations highlighted by the presenter. Once again, interpreters are encouraged to emphasize the process of data collection over the actual identification of the rock samples.

Rocks & Minerals (But Mostly Minerals)

The greatest strength of this program is the manner in which a "resident scientist" aids in the investigation of

some common minerals and their properties. Like the volcano and earthquake programs, this lesson is enhanced with a manipulative kit which contain samples of minerals, various tools for examining their physical attributes, and two sets of data sheets. The first data sheet is fashioned in a grid pattern with mineral properties (ex. "hardness", "luster", "cleavage", etc.) placed at the top of each column and alphabetic letters along each row. The teacher distributes the minerals to the students, assigning each sample a letter in place of the mineral name. The role of the resident scientist is to define the various properties. He also demonstrates how to test for that property using larger and more pristine samples. After completing these series of tests, the students are provided with the second data sheet that contains a hierarchical graph of each mineral's properties. Students must deduce the identity of each mineral sample from the data they collected on their sheet. Finally, they share their results and rationales with the scientist who verifies their identity.

Put on Your Hip-Waders: Exploring a Pond Habitat

While this program is the most technologically challenging, it also exemplifies an immersion experience. The interpreter broadcasts while standing in the 500 gallon pond located in the ScienceWorks gallery. The focus of this lesson is to help students understand the necessities all living creatures need to survive in their environment. The remote site is provided with a series of cards which include various examples of the four basic requirements of a habitat: food, water, shelter, and space. The presenter directs student attention to a chart with a list of animals and their coordinating basic habitat requirements. Students must work within their group to provide the matching set of cards. Once completed, the interpreter takes students on an "up-close" tour of the pond and surrounding wetland. Using a hand-held camera, the presenter showcases the various kinds of fish, turtles, frogs, amphibians and plants that are living in the pond environment. From this point, the interpreter suggests that students select one or two creatures they observed and then discuss in groups the four basic habitat requirements for that organism.

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Technology Initiatives in Early Childhood Education: Planning and Use of Videoconferencing

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Technology continues to evolve. Young children and their teachers now have many use options other than traditional instructional software, paint programs, and LOGO programming tools, even though these were the perceived options just a few year ago (see Clements, 1993). Some new options today include software which: (a) reads the text of a book, (b) allows for visual representation of complex ideas using concept maps, and (c) allow the user to develop multimedia presentations. The content and formatting of the World Wide Web are also continuing to evolve to a point at which a young child might soon be able to use it without too much help. Due to their recent price drops, digital cameras are now widely available. Similarly, the cost of videoconferencing equipment is decreasing while the quality of the transmitted images and sound is improving. This last possibility, the use of videoconferencing in an early childhood school setting, is the focus of this pape

This discussion is grounded in the author's experiences with related, ongoing technology planning for the Early Childhood Development Center (ECDC) at Texas A & M University—Corpus Christi (TAMU-CC). The ECDC features a public school attended by pre-kindergarten through third grade students. Inclusion in the planning of the College of Education's newly revamped, field-based teacher education program adds to the complexity of the planning effort.

A Rationale for Videoconferencing

Use of videoconferencing is founded on the premise that providing teachers and students with opportunities to communicate with others who are external to the ECDC school is desirable and effective. While some scholars speak of leveling the playing field as a way to provide equal education, an issue of concern at TAMU-CC is one of broadening the playing field or increasing a child's opportunities to communicate with others. The ideas is to enrich students' learning in selected curricular areas while—maintaining a developmentally appropriate approach—helping them to develop communicative and collaborative skills. Videoconferencing also affords teachers with new opportunities for professional development and collaboration with other teachers. Under the "companion classroom" conception, teachers and students can collaborate on projects with each other, guided the whole while by a university faculty person who is involved on an ongoing basis.

Current views regarding constructivism also contribute to the rationale for use of videoconferencing. Constructivism holds that learning is grounded in experience and requires the active construction of new knowledge based on that experience. Social negotiation—the idea that learners should be allowed to collaborate to derive personally meaningful conceptions of ideas and experience—should be well supported by students' involvement with other students via videoconferencing. Other constructivist ideas concerning the need for student-centered approaches and active learning should also be addressed through videoconferencing. Further, aiding learning through provision of multiple perspectives should also be supported insofar as students will be able to readily share in each other's differing views on given problems and topics.

The faculty and teacher education students are also to be involved in use of videoconferencing. One intriguing related idea concerns classroom observation whereby teacher education students can use the equipment to observe teacher—student interaction in participating, remote classrooms. Given a sufficient number of participating sites, this strategy will greatly enrich education students' opportunities to see what is happening in classrooms in varied settings.

Currently envisioned users and uses of the video system for the ECDC are summarized in Table 1. The strategy is intended to maximize efficiency by allowing for use by multiple groups.

The Planning Effort: Some History

Most human endeavor is marked by complexity. Use of videoconferencing in a place such as the ECDC is no different. Planning to this point may be characterized as a slow, complex process.

Table 1.
Users and Uses for ECDC Videoconferencing

Users	Uses
Teachers	...collaborating with teachers and students in companion classrooms ...consulting with content experts in the field ...pursuing external professional development opportunities
Students	...collaborating with teachers and students in companion classrooms ...consulting with content experts in the field
Teacher Education Students	..observing teachers and students in companion classrooms ...collaborating with teachers and students in companion classrooms
Faculty	...collaborating with teachers in planning and conducting projects ...evaluating and researching effectiveness of utilization ...pursuing external professional development opportunities ...disseminating results of videoconferencing efforts

A number of systems have been considered thus far. Originally, college of education planners felt that use of a high quality V-Tel system would work best. This approach called for installation of a V-Tel hub at the local Region 2 Educational Service Center. Working in partnership with the faculty, the Region 2 staff were to schedule and implement videoconferencing sessions with other K-12 schools and appropriate professional organizations. The involved schools—led by the Coastal Bend Center for Professional Development and Technology housed in the college of education—were to comprise a consortium which would participate in ongoing strategizing and use of the system to support teaching and learning, including education students. It was later decided that high-end V-Tel systems were cost prohibitive and, accordingly, would not allow for a sufficient number of sites to be involved.

Planners also gave thought to utilizing the inexpensive C-U SeeMe desktop video application which runs over the Internet. After conducting a few "try-outs" of this application, planners determined that it provided insufficient audio and visual quality to be useable. Subsequently, new self-contained videoconferencing equipment providing acceptable quality has appeared in the market costing approximately only $3,000 per site. Depending on the exact equipment, costs for phone lines may also have to be budgeted. Although purchases have not yet been made, it appears that planners will opt for the new, moderately priced equipment, pending further research and try-out.

Planners have learned a number of lessons thus far. They include:

1. Clarify the purposes of system use at the beginning of the project.
2. Design the system beforehand to provide adequate audio and visual quality and to accommodate all potential users.
3. Try out the equipment before purchasing it.
4. Verify that proper telecommunication wiring is in place before purchasing it.
5. Identify required personnel for system operation before purchasing it.
6. Beware of hidden, ongoing costs such as those for phone lines.

While some of these lessons may appear as blatant common sense, they are worthy points to keep in mind, especially for those lacking extensive experience with videoconferencing systems.

Planning for Videoconferencing: Essential Considerations

The following lists summarize essential considerations for planning a school-based videoconferencing system. The summary utilizes a traditional instructional systems development model as an organizing scheme. It should be useful to individuals in other locales who are interested in similar kinds of planning:

ANALYSIS Issues

1. Procure funding.
2. Establish team and project director to coordinate and guide videoconference use.
3. Identify goals of system use.
4. Identify sites, users, and their locations.
5. Identify system coordinators at remote sites.
6. Research appropriate videoconferencing hardware and software.
7. Identify candidate hardware and software.
8. Verify availability of telecommunication wiring required for candidate system(s).
9. Arrange try-out of candidate system(s).
10. Select and procure system components.

DESIGN Issues

1. Select curricular areas of emphasis.
2. Identify goals and objectives for videoconference use.
3. Design support materials for users.
4. Identify required training objectives for system users.

5. Write, review, revise usage plans with project team and users.

DEVELOPMENT Issues

1. Finalize goals and objectives for videoconference use.
2. Develop support materials for users.
3. Develop required user training.

IMPLEMENTATION Issues

1. Conduct user training.
2. Begin videoconferencing.
3. Document videoconferencing uses.
4. Monitor, document, and remedy operational problems.

EVALUATION Issues

1. Measure attainment of goals and objectives.
2. Identify possible attainment of unintended goals and objectives.
3. Measure videoconferencing users' opinions and attitudes toward the project.
4. Summarize operational problems.
5. Write and disseminate evaluation report.

Closing Thoughts

Having been in existence for less than two years, TAMU-CC's ECDC stands as a wonderful locale to explore uses of technology with young children and their teachers. Currently, faculty and administrators are planning for the procurement and use of video conferencing in the ECDC and companion classrooms. It is hoped that teacher education faculty and students will use video conferencing as a classroom observation tool. Implementation of the system will no doubt provide exciting, ongoing opportunities to evaluate and research exactly how video conferencing impacts learning and professional development of those involved.

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KEYNOTE SPEAKER

IMPLEMENTING INNOVATIVE TEACHING ACROSS THE FACULTY VIA THE WWW

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From the mass media to the scholarly press, a common theme in the last several years has been that educational practice must change. Learning must become more learner-centered; educational offerings must be more flexible, more individualized; teachers must move from being "sages on the stage" to "guides on the side" with new roles such as "learning facilitators and knowledge brokers" (Tuckett, Jones, & Thomas, 1997). In addition, higher education in particular must become more responsive to the needs of lifelong learning, but probably within the constraints of less funding. And just, changes in teaching and instructional practice are notoriously difficult. Various reasons for the as-yet limited impact o ICT on educational change in higher education are well known: research, not instructional innovation, is what is valued in terms of quantifiable indicators of scientific productivity; output financing discourages risk-taking in instructional practices; the relative autonomy of instructors, of departments, of faculties, and of universities with respect to educational practice means economies of scale and critical masses of experience do not develop; the time and effort investment required of the instructor who wishes to implement ICT into his instructor practice are not only high, but frequently lead to negative experiences. Student course-evaluation forms, for example, rarely present choices relating to qualities such as "effort spent by the instructor to innovate" or "willingness of the instructor to use ICT to change his instructional approach". Instead, th instructor is rewarded for qualities such as being "well prepared" and "clear", qualities which are easier to convey when teaching in a traditional way with well-used materials than when grappling with the frustrations of unfamiliar ICT use.

As a key to the puzzle of how to do more with less, information and communication technologies are generally mentioned in the same context as the need for change (Massy & Zemsky, 1997; Moonen, 1994). New technologies, particularly those involving networking, will not only need to be integrated more into traditional teaching and increase the demand for more access to open and distance learning but their effective and efficient use will also become "an obligation" for schools and universities (Langlois, 1997). However, a particular problem associated with technology and educational change is that the impact of the use of technology in our teaching is difficult to measure. Accompanying this difficulty are unrealistic or unmeasurable expectations: using technology (or these days, the Internet) should lead to transformation of the institution, to new forms of teaching and learning, to structural innovation of the whole study process (De Haan, Fisser, & De Wolf, 1997). These are expectations which probably will never be met, nor is it clear that all forms of teaching and learning need to be transformed. Also, the impact of "small things", such as the casual and frequent communication which students have with instructors via e-mail, are apparently not easy to measure in terms of quantifiable impact indicators, but such small things are in fact quietly and incrementally contributing to quite substantial changes in the educational culture and certainly in the time expenditures of the instructor.

Thus there is a gap between vision and execution. Parallel to the calls for change are systematic analyses of barriers confronting change related to technology in schools and universities. Implementation problems relate to the difficulty in changing embedded practice, cost factors, lack of adequate support, lack of adequate staff training and on-going help, lack of planning adequate for

multifaceted change, lack of political or social will, lack of clarity of how to proceed, lack of reward structures, lack of adequate organizational and even system-wide changes, lack of time, lack of adequate access to hardware and network connections, lack of appropriate learning-related resources, lack of ideas for how to integrate new technologies into teaching, lack of fully worked out technical considerations, lack of awareness of usability issues relating to computer-based and network-based materials, lack of adequate technical preparation among instructors and students (among many sources of references to support this list of problems, see at the conceptual level, Fullan, 1991, and Langlois, 1997; at the higher-education level in particular, see Massy & Zemsky, 1997, Richards, 1998, and Seminoff & Wepner, 1997; at the level of a specific program or course, see Montgomery & McGovern, 1997, and Takle & Taber, 1996). When the many different analyses of barriers confronting implementation efforts in schools and higher education with relation to change and the use of technologies as part of change are synthesized, the following recommendations seem to occur most consistently:

- Managed change should not be technology-driven, a clear, obtainable goal and rationale for the change process must be agreed upon and technology should only come into the picture when it is obvious that technology is needed to reach the goal. Goals such as "preparing for the future" or "improving our education" are not specific enough to focus a change process. There should be a problem which all can agree needs to be addressed.
- Staff development is critical, both in terms of handling the technologies involved but also in terms of learning how to adapt to new instructional emphases such as learner centeredness and increased interaction among learners
- Change is multifaceted and multiplayer, and all aspects need to be integrated, at the institutional level, the instructor level, the student level, the supporting-staff level, the technology-infrastructure level, the curriculum level, the user-interface level, the procedural level via which the managed change is to occur
- There needs to be a mixture of both top-down (leadership, policy, vision, incentives, pressure, coordination, funding, infrastructure provision) and bottom-up (acceptance of the value of the innovation by the individual involved, willingness to move through initial difficulties as well as the unavoidable "implementation dip" that accompanies having to deal on a personal basis with the small and large problems of change and technology, adequate personal skill, access and insight to continue productively)

The pressures on a Faculty of Education to respond to changes in teaching and learning and to overcome implementation barriers are considerable. As faculties in higher-education institutions, all of the problems confronting any faculty are also felt by us. We must publish; we must obtain research funding and carry out empirical research; we may have inadequate access to the technical support needed to attempt innovation in our teaching; we are evaluated in our teaching on the basis of student satisfaction and course completion, goals not always compatible with attempting innovative practice; our attempts at innovation, when they do occur, may not fit the organizational practice of our institutions; we may not perceive ourselves any relevance in all these calls for change within our own courses. And yet we are supposed to be educating our own students to become professionals in the new type of educational environments that we do not even know how to demonstrate ourselves. We need to practice the change that we are preaching, if we even are preaching it. Who do we look to as models for ourselves?

At the Faculty of Educational Science and Technology of the University of Twente in The Netherlands, we are involved in a comprehensive change-implementation initiative, involving attention to all aspects of the change process, in which we are not only developing a new model for our education (which we call C@MPUS) that involves both "pedagogical re-engineering" but also the appropriate combination and use of different didactical methods and technologies, that we think might provide a model to other faculties of education. Among the keys to the process are (a) our own history and context, which has brought us to the point where managed change can begin, gain acceptance, and be carried out; (b) the TeleTOP initiative, which has the leadership role in managing the change process; and (c) our balance of attention to the three key features of our core principles of learning and teaching, staff engagement, and comprehensive technology design. In this presentation, I briefly describe our history and context and then the TeleTOP initiative as implementation manager for our current re-design of our educational practice. After this, more specific attention to our staff-engagement methods will be given. I will conclude with two major questions, not only for us but for all faculties of education.

History and Context: Technology and Teaching at the Faculty of Educational Science and Technology in The Netherlands

The University of Twente is one of three "technological universities" in The Netherlands, established within the last 40 years to focus specifically upon technical subjects. Thus these faculties have no arts and humanities faculties and no traditional faculties of education. The University of Twente itself however has a Faculty of Educational Science and Technology, which focuses on educational technology in the sense of both products and methods. We emphasize an

"engineering approach" to educational problems. Our students typically go to work in the training departments of large organizations, in companies and agencies designing and delivering educational resources and services, and often as members of multidisciplinary teams involved with the design and development of computer-related materials. In The Netherlands, teacher education is generally not done by universities, with the exception of training for a certificate allowing an individual to teach in the last two years of university-oriented secondary schools. Such persons already have a degree in the subject area involved. In our faculty, we do provide this training for candidates wishing such a certificate for mathematics, chemistry, and physics. However, we work intensively with schools and teachers as a partner on many inservice projects, on research projects, and as partners in consortia of various sorts. We frequently are engaged by the Ministry of Education to evaluate or stimulate educational-change initiatives in schools. One of our departments, called ISM (for "Educational Instrumentation"), has an international reputation in terms of its research and practice with respect to the use of technologies in learning. Through an on-going variety of international, national, and intra-university projects, the Department ISM has gained considerable experience in the applications of older media (such as video and single-machine computer-based learning) and newer media (such as different forms of computer-based communication, the WWW, video- and desktop conferencing, and other applications of high-speed networking). In our Department, we have been among the pioneers in the use of the WWW in teaching, starting in 1994 (see an overview of four years of experience of one particular course in Collis, 1997c). From such pioneer activities, we have moved to what might be called a "1,000 flowers blooming phase", where more than 15 of our courses, not only in the Department ISM but across the faculty, have come to make extensive use of the WWW and many other courses use other forms of technologies (for a review, see Collis, 1997a; see also a hyperlinked listing of the courses at http://to-www.to.utwente.nl/TO/project/teletop/exampl.html). All students have generous network access, free from their on-campus residences, free for the first 300 minutes of dial-up telephone charges if they live off campus. In our building, there are many computer rooms, available to students almost all the time, and students have generous access to printers, to multimedia-related hardware, to professional software packages, and to all innovative WWW-related applications. We have approximately 20 technical support staff, with high levels of skills. We have two lecture halls with presentation platforms, where computers with network connections are always available to support presentations and ceiling mounted projection devices are installed. We have a critical mass of students that are well acclimated to working in (and producing) WWW environments, to working collaboratively with each one via the networks, and to using computer communication of various sorts as part of their on-going daily routines. An organizational culture has developed for network-related computer use in our instruction, particularly WWW environments. All faculty make daily use of e-mail, and all institutional communication flows through e-mail, and increasingly, via WWW sites. PowerPoint support is commonly used in our lectures, and many students do their final masters' level projects around the design and development of computer-based, and now WWW-based learning resources.

However, despite its many achievements, our university and faculty are facing problems with regard to funding and to number of students. The university's strong technical orientation is a disadvantage in a time of a decreasing number of students coming out of secondary school with the strong preparation in mathematics and science that we require and the fact that the government has recently introduced cut-backs in student funding which bring financial difficulties to students if they are not able to move quickly through their studies. Our location in the relatively rural eastern part of The Netherlands is a disadvantage compared to the appeal of Amsterdam and other larger cities in the west of the country in terms of appealing to the sense of adventure in young students. Due to a reorganization, many of our traditional base of students are now enrolling in a new Department of Communication Sciences within the university. And, at the national level, the government has tied funding to universities very strongly to the number of students who complete a degree program, and has cut funding in general. Because the Dutch language is not much known outside of The Netherlands and Flemish Belgium, we do not have an easy way to compete internationally for beginning students (although we have a separate Master of Science Programme in Educational Training and Systems Design which is offered in English and which is doing very well, but which operates separately in terms of funding). In short, we have a problem. We need more students in our regular program. There are two general ways to find them: among those leaving secondary school meeting the entry requirements for our university but who do not wish to move to our (far-away, by Dutch standards) city; and among those who already have a degree from a teacher training or equivalent institution and who may be working in the field anywhere in the country but who would like to have the additional experience in educational technology that we offer.

It is in this context that we have moved into a period of managed change. Our faculty administration has taken the step or moving from providing a good support environment for the "1,000 flowers blooming" to the more-proactive phase of stimulating all staff, in a systematic way, to move to a new, more-flexible form of educational delivery in which we can integrate these new intakes of students with

our on-campus students in a top-quality educational program. It is the decision of the faculty administration to move from creating an opportunity climate where the interested individual can move forward to enrich his or her teaching with technology, to the more proactive position of putting forth a strategy, with funding, for stimulating managed change that creates the transition. The TeleTOP initiative is a major tool in this managed-change phase.

Becoming More Flexible: The TeleTOP Initiative and C@MPUS*

The goal of TeleTOP, started in August 1997, is to systematically support the professional development of the faculty in terms of potential applications of telematics in their teaching, and to carry out the re-design of approximately 38 courses in during the 1997-1998 academic year so that our education becomes more efficient, more enriched, and more flexible via innovative and appropriate applications of telematics, particularly WWW-based tools and environments. The Mission Statement of TeleTOP can be seen on its homepage, at http://to-www.to.utwente.nl/TO/project/teletop/

Not only because making one's education more flexible is a way of reaching more students but because it is critical to the individualizing of education on a more conceptual level (Massy & Zemsky, 1997). We had already studied a variety of ways in which education can become more flexible and identified more than 25 dimensions on which a student could be offered choices in the way he or she experiences a course (Collis, Vingerhoets, & Moonen, 1997). The most familiar choice is that of flexibility in location, whereby students can choose to participate in a course from a distance or by being resident, or combinations of these. Other flexibility dimensions include choices in timing and pace (when a course can be started, how much time can be taken to complete the course); choices in instructional approach and methods (including in media used in a course as well as in didactics); choices in the social organisation of a course (including the choice of working individually or as part of a group); and choices in forms of assignments and ways of being assessed. We have found that some of these choices are incompatible with each other, for example, the choice of studying at one's own pace may require giving up the options of group work and collaborative learning as instructional organisation choices within a course. We also are aware of human limitations on flexibility. We are a typical university faculty, where each staff member must not only carry out teaching responsibilities but also do research, supervise graduate students, and participate in internal tasks and committees as well as maintain professional identities outside the faculty. We must carry out all aspects of our own teaching, from creating to carrying out our own courses, having no layer of tutors to take over communication and evaluation tasks with our students. It is not possible to offer highly personalised education to our hundreds of students, for reasons of human constraints.

Nor do we want to. We believe that our strengths as educators lie in how well we are carrying out our "old values", particularly those of good teaching, of the development and guidance of experiences for our students in working as part of collaborative learning groups through our emphasis on design projects throughout our curriculum, and of providing the atmosphere in which our students gradually become professionals through interacting with us and with the field in both well-organised and informal ways. Also, although in the "outback" of the country, we have a very pleasant campus, the only university in The Netherlands with its own large natural setting complete with ponds, ducks, lovely trees and lakes as well as sports facilities and even an open-air amphitheatre. Furthermore, we have excellent technical facilities on campus. As we become more flexible, we do not want to loose the benefits of what we already have, but rather, we want to extend them. We do not want to become virtual.

We believe we can offer some aspects of increased flexibility while maintaining our old values (Collis, 1997b). This is what we mean by our C@MPUSapproach. In particular, by September 1998 we will be offering many of our courses to combinations of the following different cohorts of students: (a) the regular students in residence at the University of Twente; (b) part-time students, from throughout the country who maintain their own working lives and remain in their own homes; (c) students who follow our courses via real-time technologies in an "interactive classroom" in Friesland (a province in the north-west of The Netherlands); and (d) foreign and Dutch students of our Master of Science Programme in Educational and Training Systems Design. The way we can make this possible, keeping our numbers of teaching staff constant, is our approach to flexibility, of which the following principles are central:

- *Teach once, but adapt within* All students participating within a course follow the same general timeframe and share in certain key aspects of a course while being able to carry out other aspects in a variety of ways best suited to their own needs and backgrounds
- *Use good combinations of technologies and instructional strategies*: Including the blend of face-to-face and telematics, as seen in the requirement for our new first-year programme that all students be present at our physical site one day every two weeks and otherwise actively participate in our courses via different telematics environments, such as via video-conferencing for the Friesland students in the north-west of the country
- *Focus on maintaining the strengths of our good teachers and on the methods we have developed for group work and collaborative learning:* Provide the

support they will find attractive and helpful to develop new ways of extending what they already do well in the teaching and learning process. Support the group process via technology when group members do not see each other face to face.
- *Manage all this change* through an integrated combination of policy, faculty-wide strategy, recognition and appreciation from the administration, top-quality human and technical infrastructure and support, experienced leadership, and a specially chosen team. The latter is the TeleTOP team.

Key to this strategy is the idea of "pedagogical re-engineering" (Collis, 1997c; Collis & Fisser, 1998), where each course is examined in terms of opportunities to provide more flexibility while retaining its strengths. Table 1 show some aspects of the analysis process.

How TeleTOP Works

To make this pedagogical re-engineering happen, TeleTOP has the following staffing, principles of staff engagement, procedures and strategies:

The TeleTOP team and their tasks

The TeleTOP initiative is chaired by the author, who is a senior academic (the Professor of Tele-Learning in the faculty, and at the university level, the Senior Researcher for Telematics Learning Technology for the inter-faculty research Centre for Telematics and Information Technology (CTIT; see http://wwwctit.cs.utwente.nl/); a member of the President's Task Force on tele-learning policy and strategy; and also someone with extensive personal experience in the re-engineering and teaching of courses via the use of the WWW (see also Collis, 1996). The daily responsibility for TeleTOP is shared with the Director of the faculty's computer laboratory, a person with extensive experience in project management and in directing a state-of-the-art multimedia laboratory. Strategic and financial decisions are made in collaboration with the Board of the faculty. The faculty member responsible for the overall undergraduate educational program is closely involved in the planning and execution, particularly of the new approach to the first-year, and in communicating the new approach to potential students. A researcher studying the role of telematics in the changing university supports the research orientation of the project. There is a Steering Committee representing all departments in the faculty and an external evaluator has been engaged.

The team also includes five full-time educational technologists, all with a Masters degree (the Dutch equivalent) from our faculty and all having previously been students in the courses they are now redesigning. Four of the team have also previously completed a teacher-training program and all have already had successful experiences in the workforce or in other higher-education settings, several outside of the country. In addition, there are three persons employed in TeleTOP with technical responsibility: a full-time Webmaster, a part-time Webmaster, and a full-time database specialist. Graphic-design specialists and multimedia specialists from our computer laboratory are available to the project, as are members of the faculty's technical helpdesk. The team is supported by a secretary.

The technical facilities

There is a well-equipped working area whose furnishing is flexible so that small meetings can take place. A portable projection device is available to be made use of during meetings and consultations so that persons do not have to huddle around a computer screen. Each member of the TeleTOP team has a good multimedia computer, equipped for desktop videoconferencing. TeleTOP makes use of a Silicon Graphics WWW and video server, and uses an Oracle database environment.

The interactive classrooms in both Enschede and the west of the country are linked via ISDN and ATM network technologies. Each has room-size and desktop videoconferencing. The Enschede classroom has 15 networked computers on an intranet using the Silicon Graphics computer as WWW and video server. The Friesland classroom has six networked computers. All computers can support desktop videoconferencing and application sharing. All students have generous access to multimedia computers, and Internet and intranet network connectivity from their homes or residences. Through several smaller projects, we are also developing teaching materials involving video to make available on demand via the video server.

Principles underlying staff engagement

We know as researchers as well as practitioners that staff engagement is the critical component of the initiative. Not only must the teaching staff accept the innovations involved, but also it is the instructors involved who must teach in the new ways and handle the new technologies. Their competency and commitment are the key factors. Also, our support staff, such as those who work with the student administration and handle student questions, complaints, and mentoring must be equally well informed and committed. Our technical support personnel will face substantial new problems and calls on their services. Our administration must respond to the new issues and challenges that will occur, such as funding for laptop computers for all part-time students so that they do not suffer a technical-access disadvantage compared to our Enschede and Friesland and Masters Programme students. The culture must be ready, in terms of staff who have adequate experience and confidence (McCartan & Hare, 1996). Thus, staff engagement is critical, involving commitment, skills, and willingness to change. The following principles are among those that underlie our staff-engagement strategy:

- Higher education faculties do not respond well to top-down steering. Decision making and the change process need to have the characteristics of a learning process in which participation is voluntary and everyone feels himself represented (Mintzberg, 1990). Although the overall decision to change to more-flexible teaching means that the instructor will not have a voluntary choice in terms of dealing with the different cohorts of students, the many different staff-development sessions and meetings which we offer are on a voluntary basis, and those who wish to adapt their courses without help from TeleTOP are free to do so.
- Parallel to this, some administrative stimulants are valuable for a change process to move forward (Kluytmans, 1994). Each department is receiving financial compensation for each course being re-designed in cooperation with the TeleTOP team. Also other forms of recognition (for the instructor individually as well as his group) can result from participation: the administration has created the impression that being involved with this initiative is valuable and valued.
- Coordination within the faculty is valuable, so that cooperation can increase, ("from individually inventing the wheel to being able to make use of available solutions"); Boon, Janssen, & Cox, 1997, p. 43)
- The incentive to invest time in re-designing one's teaching is not only for pragmatic reasons, but also coupled to the opportunity to also make one's own teaching better in terms of enrichment, and of being able to try out some new possibilities to deal with previous problems in particular courses. The instructor's efforts are not to the disadvantage of his or her research productivity, as a number of research opportunities are available in associated with the fact that the chair of the project is also the chair of a research area in tele-learning in the faculty. This confronts the familiar difficulty in higher education of not having enough time for research, if one invests time in teaching improvement (Seminoff & Wepner, 1997).
- As much as possible, the instructor is being sheltered from technical problems, and scaffolded in his or her familiarization process with the aspects of technical competency that will need to be acquired (Juge, Hartman, & Truman, 1997).
- We are fortunate in our good instructors; we want to build on their strengths, not ask them to abandon them. New ways of teaching more flexibly do not mean that the instructor needs to loose the social and communicative contact that he or she now enjoys with students (Collis, 1997b; Langlois, 1997).

The TeleTOP method and staff engagement

During the first two months of TeleTOP, seven different open sessions were offered to staff, led by the TeleTOP chair, in which a variety of examples of new teaching strategies and WWW-based tools are being used within courses in the faculty. (See the TeleTOP site, at http://to-www.to.utwente.nl/TO/project/teletop/appideas.html) for the way the pedagogical re-engineering ideas were organized and demonstrated). Participation was voluntary, and good. Between 20 and 40 staff members came to each session. Some time was spent in giving staff some introductory lessons in how to change a word-processed file into a html file and how to change a PowerPoint file into a set of html files. Meanwhile, different informational meetings were held, and formal visits were made to the administration of each department in the faculty, to discuss issues involving staff involvement.

The actual method used for course re-design is also innovative and based on the above principles of staff engagement. A decision-support tool (DST) was built which is WWW based and integrated with a database environment (De Boer & Hamel, 1998; De Boer, Strijker, & Collis, 1997; Fisser, De Boer, Peters, Verheij, & Collis, 1998). The DST tool is designed as a tool for support of a structured interview involving the TeleTOP chair, at least one of the design team, and each instructor whose course is being re-designed. The tool and procedure were pilot-tested in December 1997, after which some intensive revisions were made. During January 1998, the tool and procedure are being used with the instructors of all the 38 courses being adapted. During this one-hour interview, the instructor is asked a series of questions about what he or she would like to see added or changed in his or her course, following the pedagogical re-engineering framework shown in Table 1. For each possibility, a link is provided via the DST to a WWW-based example of what the possibility looks like in current practice in the courses in our faculty which already make use of the WWW for course support. The members of the TeleTOP team interact intensively with the instructor, trying to identify which ideas and approaches are most likely to be acceptable and interesting to his or her, and to respond with ideas and suggestions, as well as to skip suggestions which do not seem like they will be comfortable for the instructor. When the instructor indicates he or she finds a feature interesting, it is selected via the decision-support tool (DST). When the interview is completed, the DST automatically generates a WWW page for the instructor in which he or she can further examine the choices that were made via any WWW browser or by studying the printout.

Within a few days, the TeleTOP team members visit the instructor in his office, and walk through the first prototype of his course WWW site. This fast turnaround is possible because of the way that the DST is linked to an underlying database, and our own, possibly unique, method of rapid prototyping. The instructor's first prototype represents all the structure and functionalities that could be available in

his eventual course site, but without any content other than minimal example material, and with only minimal attention to the visual aspects of the user interface. The TeleTOP team members and the instructor walk through this site, and discuss possible additions or deletions. (Changes can be continued to be made for a number of months). All of these first prototypes are available as links through a closed shared workspace, accessible only to those involved in TeleTOP. This process of interview and use of the DST to develop a first prototype is taking place for 38 courses and will be completed by the end of January 1998.

The second phase of the TeleTOP Method, comprising about three months, consists of three parallel activities. One of these is continual staff involvement and professional development, based on weekly hands-on sessions for TeleTOP instructors only, in which the instructors will learn to work with their own sites and handle the amount of content-entering and minor site modifications (i.e., to the wording of a page, adding some notes, etc) that we have found to be necessary in practice. Parallel to this, is the on-going development of the course WWW sites, evolving from the first to second prototypes. Linking these first two activities is the device of using the instructors' own evolving sites as the media for their hands-on activities. Based on what options the instructors are most interested in, we will tailor each week's session to focussing on those options and how the instructors can be comfortable with using them within a WWW site and for teaching. The third of the parallel activities is also important: we have invited instructors who are interested in developing new approaches to lesson presentation, especially approaches that make use of real-time collaboration and interaction among students both here and at a distance, to join us in a "Working Group" to study together the new didactics that we want to use. For example we are interested in strategies to capture the major moments of an instructor's face-to-face presentations or class sessions and make these available via the course WWW sites via synchronized multimedia available on demand to the students whenever and wherever they want to review a presentation. But we know that instructors will need time and practice to be comfortable with these techniques. Thus the Working Group will be an opportunity to invite staff to join in on the development of our new didactics, as well as to practice in advance. To demonstrate these new pedagogical approaches and the use of the technology involved, the Chair will volunteer one of her own courses (from March-May 1998) as a demonstration basis for the rest of the faculty. Faculty will be invited to participate, to drop in, to take part in debriefings, and to discuss among themselves which of the pedagogical approaches they find most feasible for their own styles and subject areas. Faculty engagement is major aspect of our strategy.

Does the TeleTOP Approach Generalize?

The TeleTOP project is only in its first year, but the interest of the faculty, the university and from interested people outside the university is already high. We see TeleTOP as a strategic step towards a new model for the traditional university, that of extending its strengths with telematics-enhanced courses. The portability of the TeleTOP method to other settings is however, one of our on-going research questions. These include:

- To what extent is the evolution from tolerating the pioneer to non-structured support of volunteers to systematic management for change an evolution that each faculty must go through? Can a phase be skipped? What about a unit with no highly-motivated pioneer? What about a faculty with no supportive culture for computer-related educational change?
- Our faculty is biased from the start, certainly toward technology, but also with many academic staff members whose research and professional identities relate to innovative use of new technologies in education. What about faculties of education without this bias? Can the TeleTOP approach generalize to such faculties? What aspects would need to be modified?

In any case, pressures for change in terms of course delivery in higher education will continue, faculties of education will be expected to model what they are preaching, and information and communication technologies will be part of both the problem and solution. The rapid emergence of WWW-based environments since 1994 offers a heightened variety of ways, both technical and pedagogical, to accompany educational change in faculties of education, but strategies for support and engagement of all the staff at the faculty (or institutional) level will be critical in winning the needed commitment and skill. Changing one's teaching has been likened to "rowing against the stream" (Boon, Janssen, & Cox, p. 10) or even worse; without integrated and managed change strategies, faculties of education will not be able to prepare teachers for such change, or model such change in their own teaching.

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